PUBLIC LIBRARY

AMERICAN MACHINIST

A JOURNAL FOR MACHINISTS, ENGINEERS, FOUNDERS, BOILER MAKERS, PATTERN MAKERS AND BLACKSMITHS.

VOL. 16, NO. 46. WEEKLY. | NEW YORK, THURSDAY, NOVEMBER 16, 1893. | $3.00 per Annum. SINGLE COPIES 6 CENTS.

COPYRIGHT 1893, BY AMERICAN MACHINIST PUBLISHING COMPANY. For Sale Everywhere by Newsdealers. ENTERED AT POST OFFICE, NEW YORK, AS SECOND CLASS MATTER.

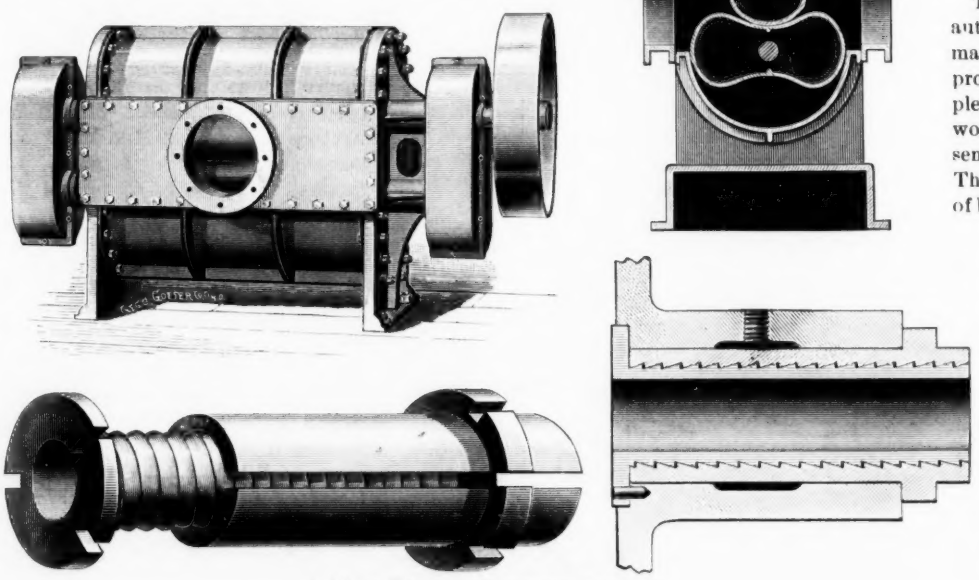
A New Rotary Positive Blower.

In our issue of July 27th we illustrated and described a machine for planing the impellers of a rotary positive blower, the special object of the machine being to give to the impellers the cycloidal form, the advantages of which were then briefly referred to. In order, however, to make this present description complete, we should state that the objects which seem to be admirably attained by this form of blower are, that owing to the well-known peculiarities of the hypocycloidal and epicycloidal curves when working together in this way, there is in this blower a continuously progressive point of contact between the two impellers; that is to say, the contact or the point of nearest approach (which in this case is meant by "point of contact") does not jump from one point to another as the impellers revolve, leaving pockets in which air may be alternately compressed and expanded, but the air is instead constantly and steadily driven before the regularly advancing point of contact, the result being that the action of the blower is smooth, steady, and conducive to the highest economy.

Another result of this form is that at all times the convex surface of one impeller is in contact with the concave surface of the opposite impeller, the result of this being that the length of contact or the distance through which the compressed air would have to pass to get back between the impellers is very much increased over what it would be were two convex surfaces opposed to each other, this, of course, conducing to a minimum of leakage. These features necessarily tend also to produce a very steady and uniform delivery of air, this feature of its action making the blower especially well adapted to such purposes as pneumatic transmission where a moderately high and steady pressure is important.

As to the general design of the machine, our illustrations show it very clearly. As will be seen, the casing is so constructed and ribbed as to eliminate the tendency to spring out of form so far as possible, either in boring or in subsequent use, and the shaft boxes are of a new form, which, while it has been successfully used for other purposes, is new to this service, being so constructed, with threaded sleeves, that it can be readily adjusted to take up wear, such adjustment tending to preserve the position and alignment of the shafts, and not disturbing the relative endwise position of the journal bearing, and that of the sleeve in which it runs, so that there is no wearing to a new bearing after adjustment, with its attendant risk of increased friction and heating. A sectional and a perspective view of this journal box are given.

These journals are also so arranged as to occupy the entire space on the shafts from the gears which connect them to the ends of the impellers, the result being that the shafts are not only thoroughly supported but the necessary length of the machine for a given proportion or capacity is reduced to the minimum; dirt and dust are excluded from the bearings and all oil escaping from them goes either to the inner end of the bearing where it lubricates the radial surfaces, or it goes into the gear casings, which are so arranged as to exclude dust.



A New Rotary Positive Blower.

It will be noticed that the journal boxes are supported upon hubs, which are cast solid with the heads, and that radial ribs run out from these hubs to the outer edge of the heads where they are bolted to the cylinders, thus making a rigid construction.

Where the machine is used as a gas exhauster, the tar and water which accumulate within the casing are removed through a trough and pipe, which are placed just at the exit from the casing, in such a position that the lower impeller sweeps the tar and water up to the trough, from which it flows through the pipe, this position giving the advantage that the pipe opening is at all times subjected to an outward pressure, which tends to maintain the flow in the pipe, and secure the benefit of its full capacity.

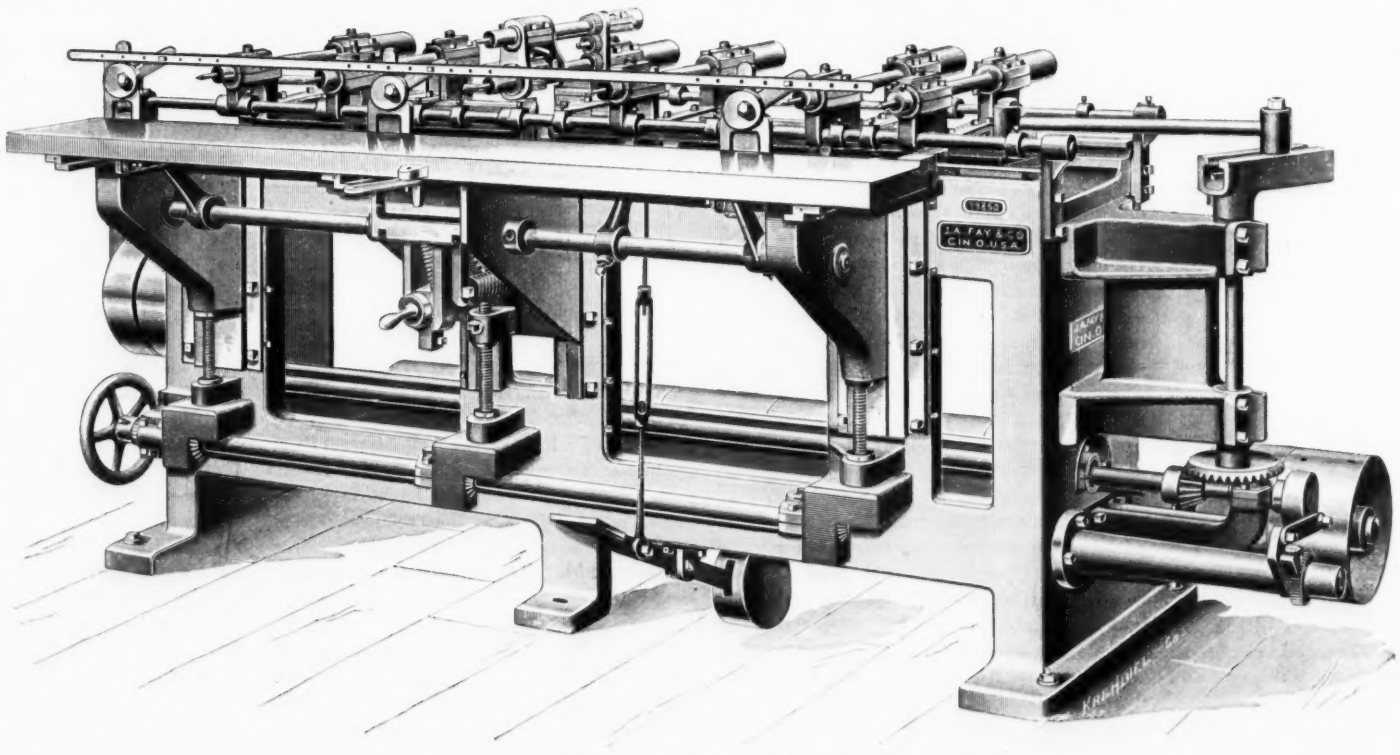
These blowers are built in all sizes, and for all the purposes for which blowers of this type are usually employed, by the Connersville Blower Co., Connersville, Ind.

Automatic Mortising Machine.

The accompanying illustration is of an automatic, rotary, reciprocating, mortising machine, which is designed to expedite the production of furniture, agricultural implements, sash, doors, blinds, and other work where duplication of parts is an essential feature in economical construction. The machine may be made with any number of boring spindles, and of any desired length.

The spindles of the machine are all driven from a single drum at the back, and are given a reciprocating motion by means of the crank and connecting rod seen at the right-hand end of the machine, the other end of the rod being connected to a frame which slides in planed ways on top of the frame, and carries the spindles with their supports and journal boxes. Each spindle can, however, be made to cut a mortise of a different length, from the size of the bit (which represents no lateral movement of the spindle) up to 12″, which is the maximum movement, the movement of the separate spindles being regulated by means of stops set according to the length of mortise desired.

The machine shown in the engraving is equipped with six boring spindles, one of which is arranged with a radial spindle attachment that renders the machine capable of producing a mortise out of line with the others. Any or all the spindles may be so arranged.



Automatic Mortising Machine.

The table is of iron, and has an automatic movement for the depth of the mortise that can be increased or reduced to suit various kinds of material being operated on. The table returns rapidly to the original position as soon as the proper depth of mortise is reached; it has a vertical adjustment of 8″, and a horizontal movement of 6″. The material is held rigidly on the table by positive clamps, which can be easily released. The machine is made by J. A. Fay & Co., Cincinnati, Ohio.

The attempt to use compressed air on the suburban railways of Paris is about to be again tried.

A Brass Furnace.

BY ISAAC WHITEHEAD.

If I want the latest design, or the most modern thought in machine shop practice, in any new work I want to do, I refer to the alphabetical indexes of the yearly volumes of the AMERICAN MACHINIST, and find them very useful, and to those who do not have them, they can be consulted at almost any library. It is an encyclopedia of mechanical practice up to date. I mention this as a suggestion to the many apprentices who have not tried it, as well as a great many other seekers after knowledge, as shown in the Question column.

Some time ago I wanted to get all the information I could upon the best construction for a brass furnace, as we desired to build one for the shop, and after seeing several styles that are in use around here, together with the criticism and points I found recorded in the AMERICAN MACHINIST, I decided upon a design which I think has so many advantages over all others I have met with, that I wish to add it to the list.

The observations made in regard to the merits of cast or wrought iron casing, which are made by Alex. Cairns in a paper upon this subject which appeared in October 29th, 1891 issue, are very good, and I would further add that I have a decided preference for the square cast-iron furnace. It takes less fuel for the necessary fire, and there is always a more regularly distributed vent and fire through the four corners, while the furnace need not be much larger than the crucible, thus supporting its sides, keeping it more erect and central, while the corners insure the fire getting all around. The top plate also is better square in the opening, being simpler to brick up, as well as giving more freedom in placing the tongs round the pot.

A pit is first dug 4 ft. below the floor, and an 8″ brick wall laid along the front and two ends, while the back, which forms the base of the chimney, will require to be 16″ thick. Between the front wall and chimney it is 5 ft. wide inside, and as long as the number of furnaces to be put in. The floor should be cemented, and the top of the 8″ wall should be capped with a ½″ thick plate, the surface being checkered to prevent slipping, and a ledge formed to receive the floor grating, the other end of which rests upon a flange cast on the front of the furnace. This grating is made up of bar iron, 1½″x½″, cut into 3 ft. lengths, with three holes drilled in each for ⅝″ rods, which are passed through them with a ⅝″ cast washer between each, and each grate made just wide enough so that it can be easily lifted out.

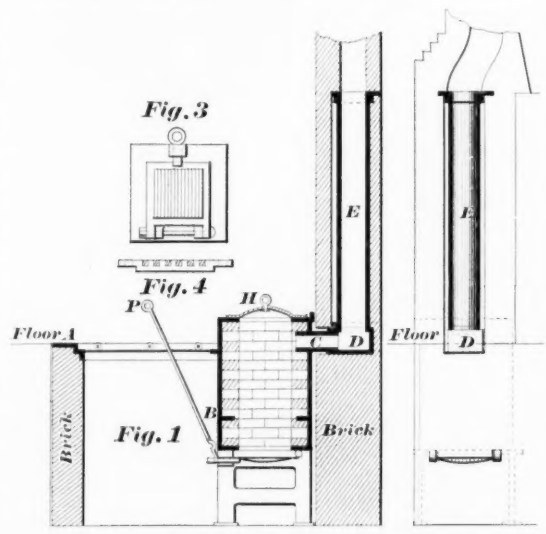
The feet under the furnace stand 18″ high, forming a deep ash-pit, and supporting the side of the furnace, as well as the adjoining one.

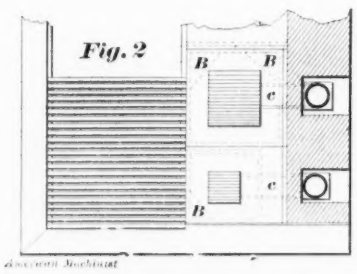
The furnace is a cast square shell, ½″ thick, with inside flanges cast on the top and bottom, with a hole for flue cast through the back side, about one thickness of brick from the top, and the size of a brick 4″x8″. Fire brick we use here are 2½″x4½″x9″, and, of course, it is best to figure from the common size you use generally. Pieces of flange are cast at about three rows of brick from the bottom, say across each corner as shown at *B*, Figs. 1 and 2, so that the lower brick, which burns out quicker, may be renewed without disturbing the upper.

A square grate is shown in Fig. 3 for the bottom of the furnace, which is hinged by two lugs cast on the bottom, and held up on the front by a square bolt, with a hole in at the front, so that a bent rod can be passed through the floor grate from above with which to draw the bolt when we wish to drop the grate, as shown at *P*.

Another plan of grate I have used is made by bolting two grate bearers on the bottom, as shown in Fig. 4, and using a number of cast or wrought-iron bars cut to length; in dumping the fire each bar requires to be drawn out from the front separately, the advantage being a ready renewal of the bars when they burn out.

The flue arrangement shown is a specially good one, as it prevents the chimney or entering flues being damaged by the heat, and the constant rebuilding of brick constructed flues, etc. The cast pipe *C* for the 18′ furnace is 4″x8″ outside to enter the opening in shell, bedding it with fire-clay inside the brick, while the other end enters into the square box *D*, upon which the stand-pipe *E* rests. Of course this pipe *C* will require to be longer for the smaller furnaces, as there is a greater space between the furnace and chimney. The stand-pipe *E* is about 5 ft. long, being a common cast-iron soil pipe. When the pipe *C* requires to be renewed, the pipe *E* can be raised, and square box *D* drawn out with the pipe *C*, and quickly replaced again. The whole of a separate furnace case may be lifted out if desired, in relining it. The length of the pipe *E* is exposed for radiation, so that the chimney does not receive the effects of the excessive heat. Two flues may be joined into one after passing into the chimney, and ordinarily a draught of 25 or 30 ft. is good





A BRASS FURNACE.

in practice, as by this arrangement the flues can be kept perfectly clean.

If the pit is built at one corner of the shop, a door may be made from the outside by which the ashes, etc., may be taken out of the pit, then, in that case, it might be desirable to make the pit 6″ deeper, thus bringing the top of the furnace level with the floor, giving more head-room to clean it out without lifting the floor grates. If the chimney is an inside or partition wall, the radiation from the stand-pipes may be inclosed for baking cores.

A cheaper way for the molder and pattern maker is to make the furnace case by casting separate plates for front, sides, and back, bolting them together on the outside by two through bolts, as shown by Alex. Cairns before referred to. Only two simple patterns are needed—one side plate which, with a little change, will make all four sides for all the different sizes required; and a top which will answer for a bottom plate as well; with care all the furnaces may be made from those two patterns. I prefer the solid casing, as it is neater and more substantial.

The cover is sometimes made of two plates, with staple handles cast in them to draw them together over the top. The same with a case lining I do not think much better, as these half covers burn in the center of the joint, which expands, leaving an opening in the joint. The best, taking all into account, is the cover as shown at *H*, Fig. 1, which is from ¼″ to ⅜″ thick wrought-iron beaten concave, like the lid of a saucepan. The expansion by heat is spent in enlarging the dome, leaving the flange to fit fairly on the top.

Two of the largest brass molding shops in New England use independent furnaces. I should judge that the building up of furnaces of brick only is going out of date, as there are so many economies in favor of casing.

The small furnace shown is capable of melting 100 pounds, and the 18″ about 350 pounds at one time. I. WHITEHEAD.

Steam Power and Electricity in Switzerland.

BY J. C. MONAGHAN, CONSUL.

Just now Saxony, of which Chemnitz is doubtless the most important manufacturing center, is interested in the comparisons being made in Switzerland between steam-power plants and electricity gained by utilizing water.

It used to be urged that Switzerland's water supply, if properly utilized for obtaining electricity, would reduce very considerably her cost of production. Not only has she many streams, but they fall from such heights that even rivers of small volume have great power. "Millions of horse-power are going to waste in these hills," was a common expression. "Switzerland had only to make sluices, put in wheels, lay wires, and get for a 'song' what other less-favored nations had to buy with enormous consumption of costly coal," was what even scientists said only a few years ago. The sluices were laid, dams made, wheels hung and wires put down. What is the result? Every effort that science could suggest, ingenuity devise, or mechanics arrange was made in different cantons of the little Republic to gather electricity by and transmit it from her rivers and streams. The latest reports show that if Switzerland, or any country with streams and climate like hers, is to win her way into the world's markets and take a place in the front ranks it must be by some better method than the use of electricity gained and transmitted from rivers and waterfalls.

The following table just published in Chemnitz shows what 50, 300 and 500 horse-power costs in England, Germany, Bohemia and Switzerland per annum:

Country.	50 horse-power.	300 horse-power.	500 horse-power.
England.....	$24.24	$12.58	$9.88
Germany.....	29.21	15.52	13 51
Bohemia.....	27.50	14.74	12.97
Switzerland....	46.82	29.61	25 54

Compared with the above the cost of the same amounts of horse-power of electricity transmitted 3.1068 miles (5 kilometers) in an air line in Switzerland, according to results published in connection with the foregoing table, is as follows: Fifty horse-power, $30.88; 300 horse-power, $16.98; 500 horse-power, $12.54. But to this must be added the transmission cost, which will make the total as follows: Fifty horse-power, $57.68; 300 horse-power, $31.27; 500 horse power, $25.48.

How, at these rates, is it possible to turn from steam to electricity? How is it possible for a people using so uncertain and expensive a power to compete with England, Bohemia, Belgium or Germany? It is only by building a big plant, 500 horse-power at the very least, that electricity begins to show any profit that would commend it as a substitute for steam. It is only then that its prices sink to those of the same amount of power yielded by its rival. The 50 and 300 horse-power gained by steam, even in Switzerland, come cheaper than the same amounts of electric power produced and transmitted from the rivers. These facts may be disappointing, but there they are—the results of experiments.

Switzerland, with its freshets, its uncertain supply of water (for, though there may always be enough, there may at times be too much), its icy winters, its electrical disturbances during mountain storms, and its dangers from high-strained change currents, causing much inconvenience and labor in laying, caring for, and repairing the wires that carry the currents over long distances is, after all, hardly the best place in the world for this experiment. What is true of Switzerland is true of other countries in the degree that these difficulties appear.

Add, then, to all these the necessity of keeping up a large reserve steam plant to carry on business when, from any of the causes cited, electricity fails. It is not claimed, however, that at all times and under all circumstances it will not pay to obtain power from streams and transmit it in the form of electricity. Where work is carried on day and night, in cases where the power is used also to supply light (which it does at very small cost), it can be made to take the place of coal at cheaper prices. Again, some streams are much better suited for electrical power purposes than others, and are often much more easily utilized. Then, too, there are valleys and places wherein the transmitting plant need not be very long—less, perhaps, than three miles, or not even half a mile. In such cases the transmitting plant, which increased the price almost double in the case of 50 and 300 horse-power, and more than double in the case of 500, need be neither very large nor very costly. In the exercise of foresight, common sense, scientific knowledge and skill, there is no reason why, with the many new inventions in the field, later experiments may not result in still further reducing the price per horse-power. With our many rivers of large volume there is no reason why the results should not be more favorable than those made among the Alps.

Just now the experiments being made in Switzerland are of vital interest to us whose mental efforts, if not practical experiments, are bending towards a utilization of the Niagara, Mississippi, Merrimac, and other streams for the purpose of supplying electrical power to the mills and shops of the United States.

Entering the Winter with Rolling Stock Run Down.

The indications are that the railroads which derive their principal revenue from the transportation of farm produce, coal and necessaries of life will soon be doing as much business as they performed before the panic began. The outlook for the coming winter is that those railroads not dependent upon metallurgic or mining products will have a good business. The crops have been above the average in yield, which provides a sure source for a steady business. The stringency of the money market prevented for a time the buying of farm produce, and the same influence has delayed the movement of coal and other supplies that must be provided for the winter. There are now indications of unusual activity to make up for lost time, and the railroad companies will be the first to enjoy the benefits.

Very few railroads have their rolling stock in a condition to handle a rush of business during the winter months. A blind policy of cutting down shop forces has been pursued, and all work not absolutely essential for present needs has been shut down. Not a few of the managers acted as if there was no future. Most of them are now wakening up a little, and increase of force and lengthening of working hours is the rule of the day.

When the nights are long and dark, there will be full working hours in many shops, and much overtime going on. This will

compel the companies to pay a large premium for the small savings they effected by reduction of force and of working hours at the time when the work could be done to advantage. The volume of business has not increased very greatly yet, but some of the roads have every locomotive fit to haul cars in service. Should the winter prove severe, the roads that pursued the waiting policy are certain to be in a frightful condition. There are hundreds of locomotives waiting to go into the repair shops, and there are miles of cars obstructing bad-order tracks. The working forces have been demoralized by the discharge of the best men, who refused to accept reduction of wages, and those remaining in the shops are not likely to work zealously to push the much-needed repairs. The master mechanics and master car builders, upon whose heads fall the burden and responsibility of getting the neglected rolling stock into working order, will find themselves in a most unenviable position. They were generally opposed to the policy of senseless reduction; their advice was generally in favor of putting the machinery in order at the season when men could work to the best advantage. Since their advice went unheeded and chaos has come, they are called upon to put things to rights, and they will be blamed if they fail to do it at small expense. The coming winter is certain to witness roads blockaded with cars, because there are not locomotives enough to move them, and freight delayed because there are not cars to haul it.—*Locomotive Engineering.*

Columbian Exposition Notes—XVIII.

Editorial Correspondence.

A German establishment which seems to give special attention to cold sawing machines for sawing metals, is that of Heinr. Ehrhardt, of Dusseldorf, Germany, who exhibited a number of such machines, that were shown in operation and attracted considerable attention.

One of the leading machines of the exhibit is shown at Fig. 100, where a ram similar to that found in our shapers carries in front a head on which are placed the bearings for the saw arbor. This head is so arranged as to turn in a vertical plane the same as the head of a shaper, the saw being thus made to stand at any desired angle to the platen, the adjustment for this being by the worm seen at the top. The

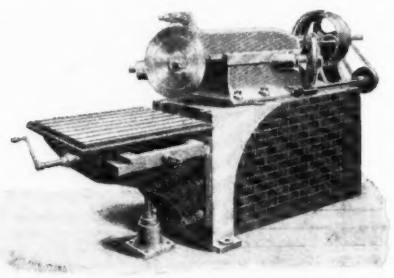


Fig. 100.

driving motion for the saw is through the medium of a shaft, which passes longitudinally through the ram and is connected to the saw arbor by bevel gears. The forward motion of the ram for feeding is by means of the spiral gearing at the side, the shaft placed at an angle with the ram carrying at its inner end a spiral pinion engaging with a rack on the ram. The platen has the usual movements of a milling machine, and by the same means.

Our engraving was not made from the identical machine shown, but is a reproduction of a German engraving made from a previous machine, the explanation of this being that I found it better for my peace of mind as well as in other respects to avoid the official photographer so far as possible, though in many cases this was of course impossible. My impression is that the machine shown at Chicago has a base made entirely of iron, instead of being composed largely of brickwork. At any rate, I think it will be generally agreed that it ought to have been so.

At Fig. 101 is shown another machine which was included in the exhibit, this being, as will readily be perceived, a universal machine in the sense that the saw can be placed in any position whatever, and made to cut at any angle, its feed motion taking place at an angle of about 45° from the vertical.

Attached to the base at the rear is a vertical column, through the center of which passes a vertical shaft from which the driving motion is derived through the

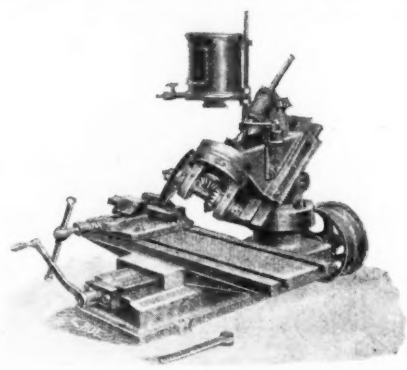


Fig. 101.

medium of the bevel gears seen at the top of column. This column is in two parts, as shown, and is joined by flanges and bolts which allow it to be turned in a horizontal plane to any desired position. Then the head which carries the saw arbor can also be rotated and set at any angle upon the slide, as in the last described machine. The saw is automatically fed downward by the rack and pinion at the right of the slide. Most American designers would probably have made the lower portion of the column of rectangular section, and larger where it joins the base; and they would almost certainly have made the slide upon which the platen moves toward and from the column much wider, and with square instead of angular side bearings; but the machine is seen to possess good points, and this as well as all the others in Mr. Ehrhardt's exhibit are neat in design and apparently very well built. Besides these typical machines, there are others that are noteworthy. Among them, one that is a sort of jig saw, whose office it is to saw out openings in sheets or plates of metal, a hole being first drilled to permit the saw to pass through, which is then given a vertical reciprocating motion, the slide, crank, etc., for effecting this being at the end of a swinging arm, which is hinged in the middle of its length much the same as some of the plate countersinking machines we have illustrated, though this machine is very much heavier and more substantial. Arranged in this way the saw can readily be made to follow any line or pattern laid out upon the plate, the saw blade used being little if any wider than thick—about $\frac{1}{4}''$ to $\frac{3}{8}''$.

In issues of July 20 and 27, the exhibit of J. E. Reinecker, of Chemnitz, was reviewed. I have received a letter from Mr. Reinecker in which, after referring to this review in a pleasant way, he says:

"I wish to give you some explanation on some points in which you did not quite find out my intentions.

"About my backing-off machines, I have to state that I am building these since 1881, first for my own use. Needing a good many cutters at that time for sugar-beet knives, of which I make a good many, and being unable to get a relieving machine from outside, I had to construct it myself.

"After completing the first one, I wanted a second one, fit not only for backing-off cutters, but for making taps and similar tools as well, with either straight or spiral grooves, the demand for relieved taps being much on the increase at that time. The result of my exertions was a lathe with a spiral relieving attachment, the principle of which was much the same as that of the machine exhibited in Chicago, though that lathe in all its parts was too lightly built to do any heavy duty.

"Relieved taps getting out of favor pretty soon, they giving satisfaction but in few special cases, I discontinued improving this lathe at that time, preferring the plain, backing-off machine for formed cutters, which, to bring into favor in our country, I had made my task. This first cost me a good deal of money as well as annoyance, and many a loss of patrons by my persistent efforts to make them friends with the backed-off cutters instead of the old style; but at last I succeeded, and now I dare say relieved cutters are more extensively used in our country than they are in the U. S. A.

"After getting through with gear cutters, I attacked formed cutters in general, and here I soon found out that relieving in right angle to axis will not suffice in all cases. This led me to construct the mechanism for relieving at any angle suited to give the best cutting edges, and though the angular relief or clearance is wanted only in special cases, it is, nevertheless, the only means of profiting by the many benefits of relieved cutters in all cases. Especially with cutters for vertical spindle milling machines, angular relieving often is of the highest value.

"It is but a short time since I went back on my old backing off lathe for making spiral grooved tools, and that happened in this way: Of late regular hollow faced worm-wheels getting more in favor in our country, also means for cutting them by positive gearing with the hob, undoing the old way of first cutting with a common gear cutter, hobs with clear cutting edges came to be necessary to insure a perfect, clean and fast cut. This could be done only in the same way as I used to relieve taps, by relieving these hobs on a lathe similar to the old one referred to. This new lathe had to be with spiral attachment in order to enable relieving of hobs with spiral grooves at right angles to thread, especially when pitch is coarse or thread double, triple or quadruple. While building a set of backing-off machines on these principles, I solved another problem, that of making formed cutters with spiral grooves. I often experienced trouble with relieved cutters of large breadth, by reason of their straight cutting edges, whereby, as is plainly seen, heavy strains are imposed on the milling machines. In fact, this circumstance was almost apt to over-balance the many advantages of relieved cutters, especially in big profiles and with light milling machines, while spiral grooves would avoid all these troubles. Well, I succeeded in finding means to make such cutters, as you will see by the specimens on exhibit. I am sorry I could not show the attachment itself, but the reasons are that the machine on exhibit was not intended for it, and the attachment put on it afterwards was not quite fit for show. Also I wanted to secure patent rights on it before making it publicly known. What I now wish to state is:

"First. The machine on exhibition is only an imperfect one, being of the first pattern of this class of machines, which by this time is thoroughly worked over and cleared of the faults of this Chicago machine.

"Second. Having had no time to exhibit a machine of the improved pattern, I had to take this one after it had run in my works for six months. Its workmanship, therefore, is not quite of so good quality as I should wish.

"Third. The plain milling cutter is put on the machine only to show its manner of working, to make a cut with it once in a while if anybody likes to see it run. I did not intend at all to make the advantages of the machine shown by this cutter, though I really prefer relieved plain cutters. By their strongly supported cutting edges they permit a very heavy cut; by the fact that grinding is done in the grooves, the hard surface of the tooth is spared, and the cutting edge will stand a good deal longer than in old style cutters.

"About costs of making these cutters, I must say you overestimate them. All the cutters are made with two cuts—one for roughing out and one for smoothing. I just now made cutters with a relief of 9 mm. (about $\frac{11}{32}''$) which I took off at one cut. Of course this is done on an improved machine, and the finish is very good—a good deal better than one could get it on the Chicago machine.

"The grinding has to be done on a special grinder, and I have a very simple attachment to my cutter and reamer grinder building. Grinding relieved cutters is a thing which is, up to this date, very seldom properly done. My experience is that very much more satisfaction is obtained with cutters ground on an arbor between good centers and indexed in a manner similar to what everybody employs when milling the grooves. On these principles my grinder is constructed, a sketch of which is at your disposition if you think it of value or interest to you.

"Before closing, I wish to state in regard to the measuring machine, or better, comparator, that in fact the accuracy of this little machine is a good deal higher than by mere judgment one might suppose. Of course the machine is not strictly taken for measuring pieces, *i. e.*, for finding by the machine alone their exact size, but for comparing with test pieces, and for that purpose it is in fact the best machine for everyday use you can imagine. Its action is absolutely positive, and by far superior to friction, or gravity or touch and feel system. I use two of these machines in my works, besides one of Whitworth's system. The latter is fit only for roughing out to about 0.005 mm., while in grinding to exact size my machine is used. It is simple, effective, and stands almost any treatment such as will occur once in a while if you have a new hand trusted with it.

"In regard to your remark, that my tools are largely American style, I cannot quite agree with you. My principles are to build as good as possible, to build the tools as best suited to our wants, and to avoid copying. Of course it is impossible always to find shapes and mechanisms that do in no way resemble American patterns, inasmuch as the views pursued by your people in designing machine tools must be adopted by everybody who intends to design a perfect tool. The machines contained in my catalogues which you hint at are not at all reproductions of American designs. Though from outside appearance they seem to be so, the whole arrangement inside is of quite another principle, as you can find out by the description.

"I forgot to say that a good many of the cutters are some that were made as quick and as cheap as possible for an occasional job, and taken from the tool-room without anything being done on them to make them look better. They are by no means of a full finish."

What Mr. Reinecker says regarding the development of the backing-off machine is certainly very interesting, and it is to be noted that the process of development described is very much the same and was impelled by much the same motives as prevail in the best establishments of this country. The result as it was exhibited at Chicago was certainly creditable, though the machine was so exhibited, and in connection with such cutters, as to lead one to conclude that much, and possibly the principal stress was laid upon the backing off of straight spiral mills, a use to which, as stated before, I do not think I should put the machine at all, for the reason that I think the

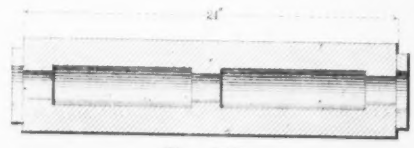


Fig. 102

milling machine that cuts the grooves will also do this work at less cost, granting that it is desirable to do the work at all, and on this latter point Mr. Reinecker's experience is undoubtedly worth much more than any other's opinion, not founded upon experience with both kinds of cutters. But this aside. Mr. Reinecker gives a number of cases in which the machine is undoubtedly of great usefulness, notably in making spiral formed cutters and in relieving large hobs that have

spiral grooves; the machine does this work admirably as specimens shown at Chicago proved.

An interesting statement is that regarding the extent of the employment of relieved cutters in Germany. It is certain that their use here is very extensive, though it may be true that their proportion to the total number of milling cutters used is greater there than here, which is probably what Mr. Reinecker means to say.

As to the matter of copying our designs I do not think what I formerly said upon that point could be generally understood as being meant for a reproach to the builder. The neat compliment to American tool builders by Mr. Reinecker exactly covers the point. It is true as stated in the first place that the Reinecker machines at Chicago resembled in general appearance some of the tools made here, and any one familiar with such matters and taking a merely cursory view of the exhibit could easily have believed that every machine in it might just as well have come from one of a few American shops. But notwithstanding this general resemblance to American designs there was amply sufficient originality in the machines to relieve the builders entirely of the charge of blind copying. The exhibit as a whole was such as to command the admiration of any unprejudiced mechanic.

In issue of August 31st mention is made of a solid spiral milling cutter 24" long 6" diameter exhibited by the Brown & Sharpe Mfg. Co. A mechanic who is especially interested in cutters calls attention to the fact that this cutter is considerably larger than those mentioned in our issues of December 15, 1892, and February 2, 1893. He does not think there is special merit, or that it is advisable, generally speaking, to make solid cutters so large, but this cutter simply shows that when they are demanded there is little trouble in producing them.

Some account of the method pursued in making this cutter may be of interest. Fig. 102 (page 3) represents a section of the blank, and it will be noticed there is a bearing at the middle of its length, the object of this being, of course, to prevent springing of the arbor between the end bearings. It was impractical to grind all three of these bearings at one chucking in the grinder because the spindle of the inside grinding attachment would not reach through the cutter, and if it were made to do so would be insufficiently supported. The plan adopted therefore was to tap in each end of the cutter three $\frac{3}{8}$"—16 holes, and by means of these the rings seen one at either end of the blank (Fig. 102) were secured to the cutter. One of these rings was then held in a chuck on the grinder while the other was run in the steady rest. The outer and middle bearings were then ground, after which the cutter was reversed "end for end," and the other outer bearing ground. F. J. M.

New Process of Cutting Cams.*

By W. A. Gabriel, Elgin, Ill.

The writer of this paper is engaged in the work of designing small and intricate machinery for the manufacture of parts of watches, and in the course of his experience found it necessary to produce cams of greater accuracy than could be obtained in old and well known ways. As a result of this the following method of laying out and cutting such cams was devised by the writer, and is made the subject of this paper.

The following is a description of the cam-cutting machines and manner of laying out the forms used therein. It is hoped that the diagrams that form part of this paper will give the reader a clear idea of the scheme.

To commence with, a chart of all the cam motions in a machine is laid out, similar to a sample diagram shown at Fig. 11, and a position line is drawn across it. From this chart the forms for the cam-cutting machines are made. Figs. 12 and 13 were laid out from the chart at Fig. 11. The position line is located on them in its proper place, so that when the form is in the machine the line can be marked on the cams after being cut. The use of this line makes it possible to place all cams in a machine in their proper place at once. The line is marked on the cams from the form while in the machine, after the cam has been cut. A pointer is put in place of the cutter, and another pointer in the place of the roll acted on by the form (Figs. 8 and 9). When the position line marked on the form is brought around to the pointer at that place, the pointer in place of the cutter is made to mark a line on the cam. When all the lines marked on the cams in a machine are in line parallel with the cam shaft, they are ready to be secured to it. It will be noticed by referring to the drawings of the machines that the levers transmitting motion from the form to the cutter are multiplying. And in this case it is five to one, and the form, of course, must have a rise or throw five times that of the cam being cut. This is done so that errors of workmanship in making the form will be reduced in the cam, and more perfect work produced.

In some cases the form is laid out on a board covered with paper, and is then sawed out, taking care not to run over the line. It is then trued up with a file, and is ready to use in the cam-cutting machine. But in cases where great accuracy is necessary, the form is laid out on sheet brass about $\frac{1}{10}$ inch in thickness, and as metal will keep its form unchanged for any length of time, a cam can be reproduced the same as the original at any time.

An instrument to facilitate the laying out of forms on metal is shown by Figs. 16 and 17. It consists of an ordinary tubular beam compass, with strong points to scratch a plain line on the metal, and an attachment at the adjusting end that will enable it to be set to $\frac{1}{1000}$ of an inch of any required distance. The large sectional view, Fig. 17, shows the construction of the adjusting nut. A steel scale with inches, tenths, and hundredths on it is used in connection with the compass. To operate it the point on the sliding head is run out to nearly the distance required, and the points are set in the divisions on the scale. A magnifying glass is used to see that the points rest in the center of the lines, the adjusting nut being used to bring that about. The part of the nut carrying the divisions can be turned independently of it. It is then set to zero, and if the distance calls for several one thousandths of an inch, more or less, it can be obtained by turning the nut to the right division. The compass is then set ready to mark a line on the form.

The sheet metal on which the form is laid out is first prepared by drilling a hole near its center, the size of the center pin in the spindle on which the form turns in the machine. The hole is then filled with a small brass plug, having a fine center point in it. This insures the hole being in the right place when the form is finished. After the form is outlined on the brass plate it is sawed out with a band saw for metal, and is then placed upon a small table and finished with a file. A fixture is attached to the table for holding the file perpendicular to the edge of the form. It is then ready to be put in the cam-cutting machine.

I will now proceed to describe the machine that cuts a groove in the side or face of a cam.

This machine is shown by Figs. 6 and 7, and consists of a strong bed plate, on which are placed two upright spindles, to carry the cam to be cut and the form. Over them, and pivoted at one end, is a strong lever, so placed as to make a proportion of five to one between the cam and form.

At one end is a roll to act on the form. Over the cam spindle is the cutter spindle, with its driving gears. Adjustment is provided up and down. The cutter spindle is driven through bevel gearing by a countershaft and universal couplings. This allows for all necessary movements of lever and cutter.

Both cam and form spindles are turned by

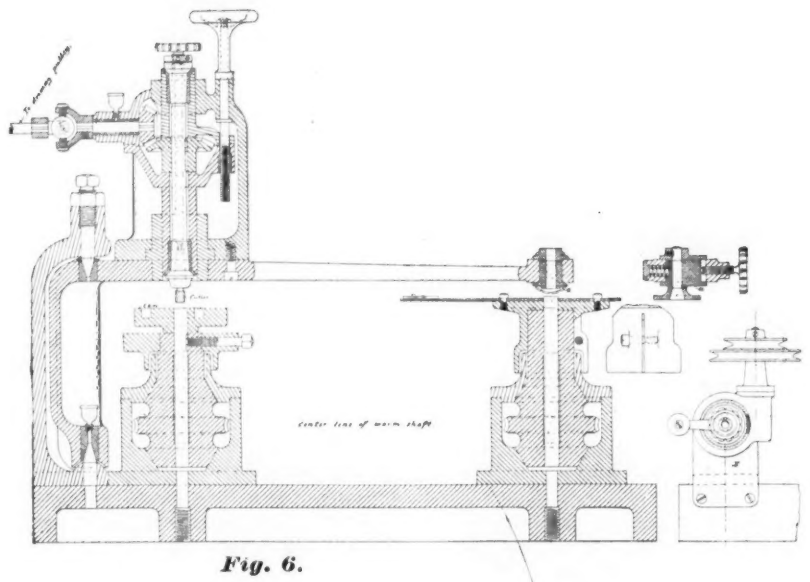


Fig. 6.

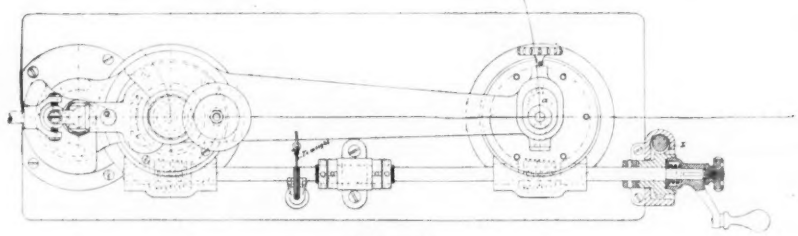


Fig. 7.

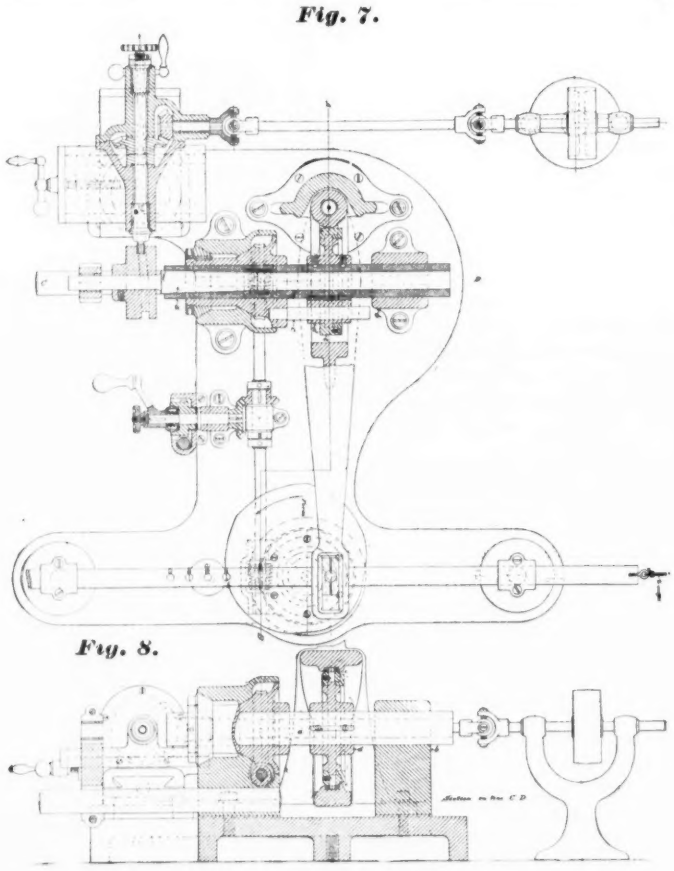


Fig. 8.

Fig. 9.

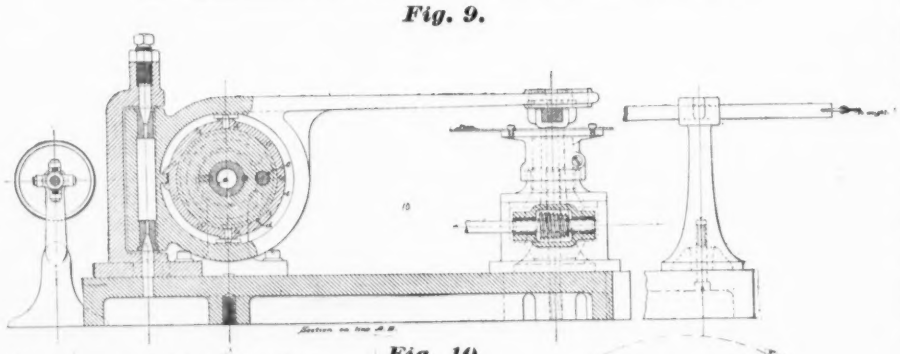


Fig. 10.

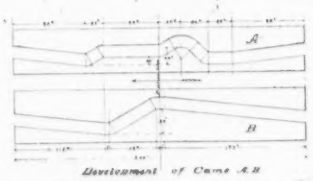


Fig. 11.

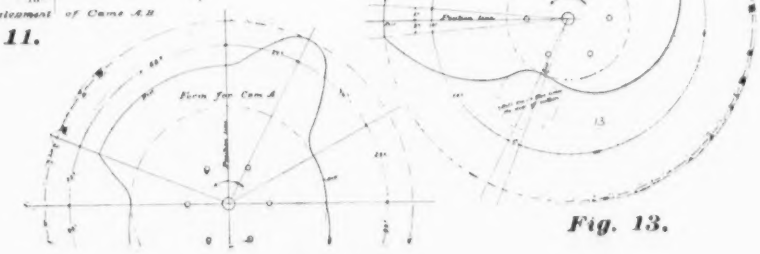


Fig. 12.

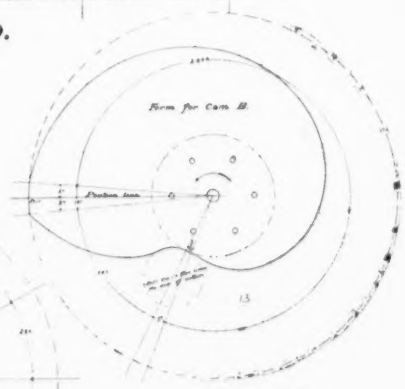


Fig. 13.

NEW PROCESS OF CUTTING CAMS.

*Paper read before the American Society of Mechanical Engineers.

worm gears with the same number of teeth in each, and are turned in the same direction by worms which are made tapering, so that side shake can be taken up.

The worm shaft can be turned either by hand or power, as is clearly shown by the drawings. The form for this machine must be just the shape of the space inclosed by the groove in the cam, and must be five times actual size. This is necessary on account of the roll and cutter being mounted on the lever. The roll should be just five times the size of the finishing cutter. A small slide in the end of the lever, marked *a* on plan Fig. 7, provides adjustment so that the sides of the groove can be finished with a fine chip, or trimmed up after being worn so badly as to require it.

The lever carrying the cutter and roll is held up to the form by a weight suspended at the end of a cord, which passes over a pulley swiveling at the top of a column, and attached to lever, as shown on plan Fig. 7. It can be seen that the machine just described is quite simple and will do excellent work.

The machine for cutting a groove in a cylinder cam, shown in Figs. 8 to 11, is more complex, but will do work as perfect as the former. In this machine the cam, being cut, is moved endwise by the form as it turns, and whatever shape the form has is given to the cam, as perfectly as in the other machine. The roll acted on by the form is carried by a bar, which moves parallel with the spindle carrying the cam to be cut. Motion is transmitted from the bar to the cam spindle by a lever, which is pivoted so as to give the same proportion of movement as in the former machine. The worm shaft can be turned by hand or power. Means are provided to take up any side shake between worm and gear. The cutter and its driving gears are mounted on a compound slide, so that it can be adjusted to position with ease. A support is provided for the outer end of arbor carrying the cam, to prevent chattering when taking heavy cuts.

The spindle *a* is free to move endwise in the outer spindle, of which the worm gear is a part, and also in the back bearing *b*. The driving pin *c* is fast in the worm gear spindle; and passes freely through a disk *d*, which is keyed fast to the sliding spindle *a*. A ring *e* which cannot turn encircles the disk *d*, and in it are pins pivoted in small slides in the lever. Adjustment is provided to take up any shake in pins or slides. This arrangement is necessary on account of the foreshortening of the lever. In this machine it is not necessary to have the form just five times the size of the space inclosed by the groove, as in the former machine; but the rise or throw must be. The form ought to be as large as convenient in order to avoid having too steep a rise for the roll to overcome. A number of holes are provided in the bar carrying the roll, to assist in adjusting it properly. A weight at the end of a cord, attached to the bar, keeps the roll up to the form while cutting the cam. Means are provided to enable the form to be turned independently of the spindle. This is useful in starting to cut the cam. A hole is first drilled in the cam blank, to start the cut. The hole is brought opposite to the cutter by turning the blank on its spindle, then the form is turned to adjust endwise. The machine is then set ready to cut the cam. The position line is marked on the cam after being cut, to avoid any chance of error from its slipping on the arbor.

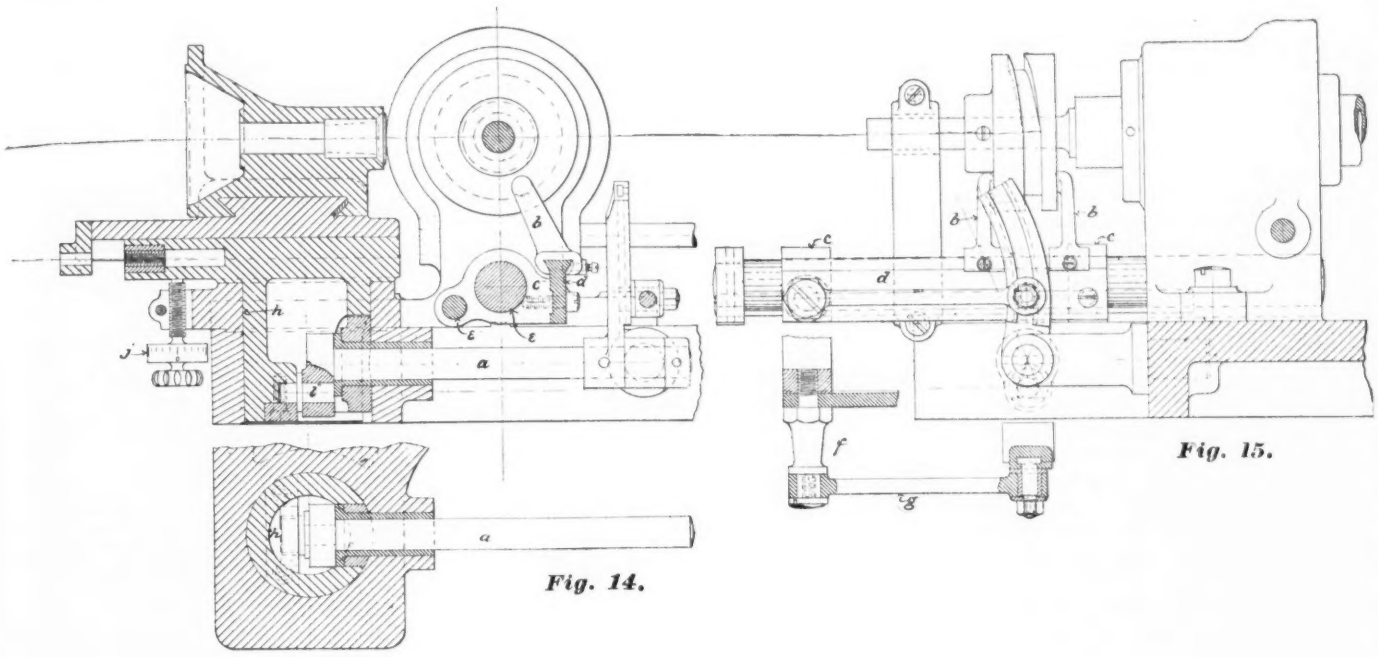


Fig. 14.

Fig. 15.

In many cases the pin working in the groove of a cam is secured in the end of a lever working on a fulcrum. If the radius of the lever be short, and the throw of the cam be great, a serious cramping of the pin may take place, on account of the foreshortening of the lever. On Figs. 14 and 15 is shown a way whereby the cutter may be moved in cutting the groove in a cam, in the same way that the pin itself would move, on account of the foreshortening of the lever. In order to simplify this problem, the pin should not work below the center line of the cam. To set this device the cam blank and form should be turned to exactly the center of the throw, and then, with the rock-shaft *a* in the position shown, the adjustable arms *b b*, Figs. 14 and 15, are moved up to contact with the blank, one on each side. The bar *d*, on which arms *b b* slide, is supported at each end by yokes *c c* which in turn slide on round bars *e e*. At the outer end of bar *d* is a stud *f* to which is pivoted a connecting rod *g*. One end of this rod is adjustable in a curved arm which is pinned fast to the rock shaft *a*. At the opposite end of the rock-shaft, and within a vertical slide *h*, is a short rocker arm carrying a flatted pin *i* which slides in a suitable slot in slide *h*. As the cam is being cut its movement endwise causes motion to be imparted to the mechanism just described; and that in turn causes the vertical slide *h*, carrying the compound slides and cutter spindle, to move up and down. In order that the amount of motion up and down shall equal the foreshortening of the lever and pin which is to work in the cam, it is first found by measurement of the drawings of the machine in which the cam is to work. Then, by means of a micrometer screw at *j*, and the adjustment of the connecting rod in the slot in the curved lever, the machine is set to an equal amount, and then is ready to cut the cam.

The writer of this paper does not think that, practically, this foreshortening of a

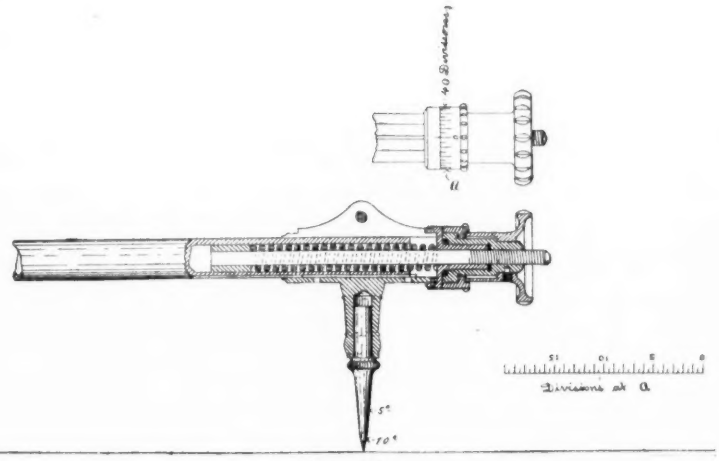
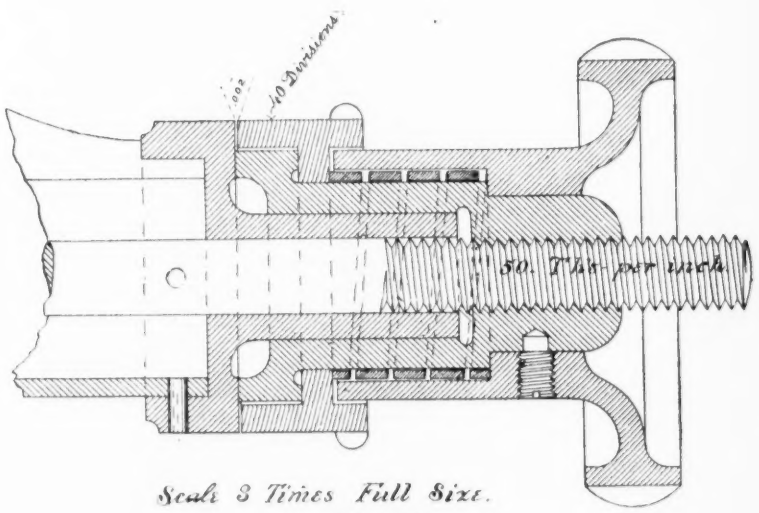
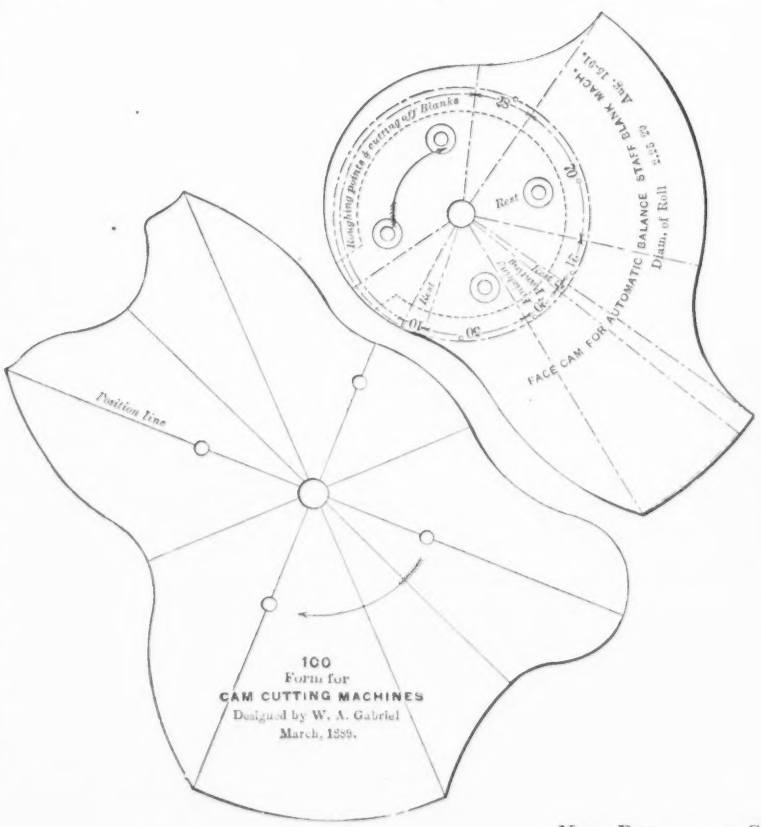


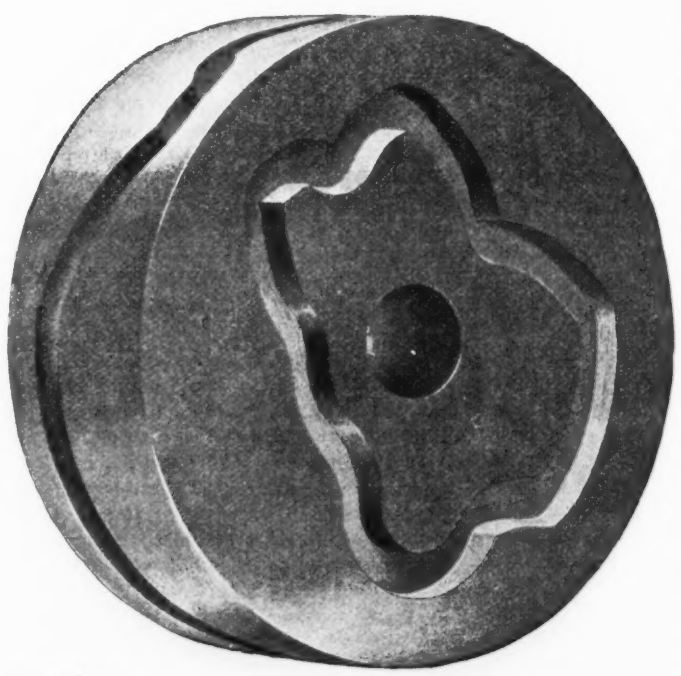
Fig. 16.



Scale 3 Times Full Size.

Fig. 17.





NEW PROCESS OF CUTTING CAMS.

pin working in a cam cuts much of a figure, as in most cases it can be corrected by rounding the pin a little. But some might think it ought to be provided for in a cam-cutting machine, and for this reason the writer thought best to describe a way by which this object might be overcome.

Two machines, on the principle of those described in this paper, have been in successful operation for the past three years, which produce work giving entire satisfaction.

It would be a source of pleasure to the writer of this paper if anything in this method of cutting cams should be of use to any member of this society.

LETTERS FROM PRACTICAL MEN.

High Tensile Strength of Bronze Castings.

Editor American Machinist:

Several months ago we received an order from the United States Government which called for a number of large bronze castings of unusual shape, and it was specified that these castings should have a tensile strength of 40,000 pounds to the square inch, with 15 per cent. elongation. We had given but little attention to brass castings, and so endeavored to obtain them from brass founders of established reputation, and several of these tried for a long time to make the castings, and gave them up. Some of the founders succeeded in getting test specimens that answered the requirements, but the requirements were not met when pieces were cut from the castings themselves, and with all there was much difficulty in having castings sound and free from excessive shrinkage.

We were compelled to undertake the work ourselves, and finally arrived at the desired results. As there was quite a long run of work, we had an opportunity to experiment considerably, and are now able to get as high as 68,000 pounds tensile strength, and with a somewhat lower tensile strength as much as 49 per cent. elongation.

Perhaps some of your readers can tell us whether these results are unusual. We should be very glad to hear from any makers or users of bronze castings.

Our metal is suitable for a great variety of pieces and shapes, and is not expensive.

"CONSOLE BRONZE."

"Cheap Imitations."

Editor American Machinist:

Did you ever notice how little originality exists in about nine-tenths of the human family? It will weary you if too intensely studied. For instance, a group of small boys were playing in front of my house when another boy came along and showed them a new toy he had bought in the shape of a parachute, the bonnet and strings of which being rolled tightly around a cylindrical piece of wood to which they were attached and thrown high in the air would unroll, and it would float gracefully down. Ten of those little chaps stood on the curbstone, and admired and envied the newcomer's plaything. That same afternoon nine of those boys were out in the street, and each had a parachute copied from their playmate's, with this difference, they did not have the wooden cylinder, but employed pieces of wood, iron, and corn-cobs, while one little fellow had confiscated the casters from the family dinner table. Of course, theirs did not go up so high, nor fall so gracefully as the original, but they seemed to have considerable excitement and fun until the tenth boy came round. Then all the interest centered about him. He had been brought up on the same block, and educated at the same school, but he possessed just personality and pride enough to avoid imitating the efforts of his fellows, and that pride spurred his originality on to produce something different and possibly better, with the result that he became a leader among his associates. He had made a balloon that sailed up and away around the corner, and the nine other little imitators promptly tired of their amusement, and chased the tenth boy's toy. And so we see it all through with the grown boys.

I remember very distinctly when a small boy "long time ago" of having to ride in a wagon over a level road; it was an all-day journey, and I recall earnestly wishing many times that something would happen to those big hind wheels so they would not forever continue monotonously following along in the ruts of the wheels in front. My mother-in-law taught my wife all the methods known to her regarding housekeeping, and had she not also inherited some original personality of her own I would have existed just as well by living with her mother, and not expected any bettering of conditions. If our ancestors away back to Father Abraham's time had simply followed after the old gentleman's pattern, we would still be 'tending sheep in the valleys around the walls of Jericho, and the mutton would be just "as cheap and good" as our forefathers', but no better.

During the roller skate craze, a manufacturer, showing me about his shops, called my attention to the "superior" merits of his goods. "But are they not just like those made by your neighbor, across the street?" I asked, as the pattern was identical. "Oh, no," he replied, "you see this little tension screw? Well, he screws his down, while we screw ours up. Our man used to work for him, and this is our improvement."

Some time since I saw a new lathe. "That is a Fitchburg tool," I said, but examination proved it to have been built in a city 500 miles from there; further inquiry developed the fact that its designers and builders had worked for years in the tool works of Fitchburg, Mass., and being of the imitation type had built in the same rut they had learned in without a single original development tending to improve its commercial value, unless we consider that useless weight was added. In fact, the only argument to be used in selling was that "it was just as good and cheaper." I can call this nothing else but cheap imitation, and it has a great deal to do with the present hard times we are enjoying just at present. Recently, I saw a turret machine copied from a western builder's patterns, and so close was the imitation that all the errors in the first machine (which its designer had discovered from experience and thrown away) were carefully engrafted in that of the "improver's" work. I also found that the "father of this improvement" was an old employe of the western manufacturer.

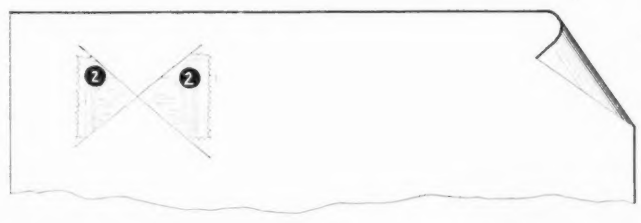
Now here is another coincidence: When I visited the machine shop in Norfolk where the saw-mill carriage was being built, I did not note that it was the Southern Machinery Company's, neither did I know that such a man as James H. Kink was ever on earth. I remarked at the time to the gentleman accompanying me that they were repairing a Stearns carriage. He answered: "Not much; this is built here." "Well, there must have been a Stearns man around when they developed it," I answered as we wandered out. I saw the essentials embodying imitation and knowing that labor and materials were cheaper, consequently it was just the same as others I have mentioned, and his communication only proves the correctness of my theory, that the machine must show the personality (or lack of it) of the designer. I have asked a gentleman familiar with the different parts and weights of the Stearns carriage to compare them with the figures given in Mr. Kink's letter, and herewith is an extract from his letter in reply:

"It is a peculiar coincidence that the dimensions and description of the head blocks in his article check almost exactly with the Stearns blocks. The only difference is that the ratchet wheel is cut and theirs is cast as I pointed out to you in Norfolk, and also the difference in the set shaft, which he states."

It is only another case of "screwing up or screwing down." The fact that a man has spent his whole life in any one branch of business or mechanics is no evidence that the business has been improved, developed or made more valuable by him, but rather indicates that the man possesses an adaptation of satisfactory concentration in that particular line. As an example we have the old-time millers who were all their lives grinding out flour between the millstones because they lacked the originality of the fellow who only spent a part of his whole life in the business and developed the idea of the roller-mill.

I always frankly admit that I am ignorant of a host of things because I thus acquire a growing fund of information through the kindness of others who would not think of telling me should they think I "knew it all," and I would suggest that Mr. Kink, provided he possesses the originality generally found from experience over drawing boards, in the shop and among mill men, and not of that kind that sometimes crawls out from between the ledger and cash books, and is mistaken often for genius and mechanical ability, to cease all further "making pretense," as he states, and develop something that will show his own personality and individualize his works and the city in which he lives.

My opinion is that there are about two hundred thousand too many would-be improved tools and machines on the market at the present time, and if it was only otherwise our country would not be wearing such a worried look. R. S. W.



Mysterious Causes of Mail Losses.

Editor American Machinist:

It is encouraging to inventors to constantly meet illustrations of the fact that there is hardly anything so good but there is a chance to devise something better. In your issue of October 12th I mentioned two ways to inclose stamps in envelopes so that they will not be overlooked and lost. Now Mr. A. H. Walton, of the Crane & Breed Manufacturing Co., thoughtfully contributes the method here illustrated.

All that is necessary is to cut two intersecting slits in the letter sheet with penknife eraser or scissors, lift two opposite lips and slip the stamp under.

Yonkers, N. Y. S. W. BALCH.

West's Cupola.

Editor American Machinist:

In your November 2d issue you publish Mr. West's ideas of a cupola, with drawing of same, as read at Chicago. I had not noticed the article at time it was read, and, therefore, was intensely interested in this number of AMERICAN MACHINIST containing it. It has always impressed me that cupolas were coal fiends, particularly so if not properly constructed. We all know it requires blast, and plenty of it, to produce heat from coal in a cupola to melt pig-iron, but how to get the blast in cupola to do the most efficient work now seems to be solved by Mr. West's central blast tuyere. What foundries have them in use, and where can they be bought?

We have changed the tuyeres in our cupola several times inside and outside in the past few years, with fair results only. Some days she would work like a charm, other days like an old hag. We must be precise in the selection of coal; if it contains much bird's-eye and slate we will not have hot iron, and bottom will not drop, iron gets dead and hangs to sides of cupola. I used to think coal was coal in a cupola, especially with a good blower like the one we have—what a foolish dream. My experience with our cupola has been we must have the very best and purest coal, and nothing but the best, free from slate and niggerhead. We tried coke with coal, and got bunged up. The West blast must be the grand eureka in cupola construction. At one time it was thought one to sixteen was impossible, and get hot iron. As his process saves fuel and linings, I must have one. The only doubt I have is, can the Thomas D. West central blast tuyeres be applied to a ten-ton cupola; might there not be some difficulty experienced in dropping bottom in so narrow a space? It is indeed remarkable in this prolific age of invention that the cupola for melting cast-iron has been ignored, when untold millions are in store for a genius who will radically improve it to produce a maximum amount of iron to a minimum amount of coal.

Mr. West states his blast was delivered from a No. 9 Sturtevant fan; we have a No. 8, which is much larger than we need for our cupola, judging from the size he used.

All foundrymen should encourage Messrs. Thomas D. West, of Sharpsville, Pa., and Thomas H. Widdowson, of Mankato, Minn., in their remarkable researches and experiments to improve the cupola and solve all mysteries connected therewith.

Reading, Pa. T. BEVERLY KEIM.

During the first six months of this year, the casualties reported to the Board of Trade by the several railway companies in the United Kingdom included 12 collisions between passenger trains, or parts of passenger trains; 16 collisions between passenger trains and goods or mineral trains; six collisions between goods trains, or parts of goods trains; one case of a train coming in contact with projections from other trains traveling on parallel lines; 26 cases of passenger trains, or parts of passenger trains, leaving the rails; eight cases of goods trains, or parts of goods trains, leaving the rails; three cases of trains or engines traveling in the wrong direction through points; 14 cases of trains running into stations or sidings at too high a speed; 70 cases of trains running over cattle or other obstructions on the line; 22 cases of trains running through gates at level crossings; five cases of failure of machinery, springs, etc., of engines; 294 failures of tires; nine failures of couplings and two other accidents. The total number of personal accidents reported by the several railway companies during the six months amounted to 524 persons killed, and 4,302 injured, these numbers including all servants of the companies, of carriers, and all who were killed or injured by being on the railways.—*The Engineer.*

The Amsterdam Rascals.

Since the publication of our editorial on Foreign Rascals, in our issue of November 2d, we have received a number of letters from makers of machinery who have been *favored* with orders from Amsterdam. Some of these letters we are at liberty to publish and we give them below in the order of their receipt:

PHILADELPHIA, PA., Nov. 2, 1893.

Editor American Machinist:

In reading the editorial in your issue of November 2d, headed "Foreign Rascals," we were reminded of an order received by us some months ago from a firm in Amsterdam, whose name it may be well to withhold for the present.

Supposing this to be a *bona fide* business transaction, we proceeded to build the machine, and, in due course of time, instituted inquiries as to the responsibility of our correspondents. In the reply received they were denounced as "government swindlers." We then wrote for a remittance in advance, without receiving any response.

If convenient, we should be glad to have you send us a list of the fifty swindlers to whom you refer, in order to determine whether the parties we refer to, are included in that number.

When we learn that there are so many Amster-dam rascals, our confidence in the time-honored reputation of the Dutch for honesty is seriously disturbed.

BEMENT, MILES & Co.

TORRINGTON, CONN., Nov. 2, 1893.

Editor American Machinist:

We notice your article "Foreign Rascals" in this week's issue of your paper. We received an order for a machine from one of the concerns mentioned in the list, but before shipping asked them to remit payment. This they refused to do till they received the machine. We then sent for a special commercial report of them, which report advised *not* to sell to them as they were beats, and living on the proceeds of what they could obtain in this way. R. Knobbe & Co., of Amsterdam, is the name of the party. THE HENDEY MACHINE CO.

MERIDEN, Conn., Nov. 6th.

Editor American Machinist:

We are glad to note that you are "onto" the "Foreign Rascals." I wonder how they all happened to select Amsterdam as their headquarters. They have been trying to work us too, but we didn't feel flattered because our machinery was so well-known abroad that we got an order to ship and bill, and any one that is simple enough to send machinery to any one (particularly abroad, though we have had one case in Michigan, U. S. A.) who don't care what he gets as long as he gets *some* kind of a machine and gets it P. D. Q., *ought* to lose it, and thank his stars he got his eye teeth cut for the price of one machine. The Amsterdam Dutchmen that tried to work us (G. Issers de Vries & Co.) first sent for a catalogue, and then tore out the cut of the *head* of a lathe, and said, "Send this lathe with bill," not saying whether they wanted a large or small one, or whether with turret or foot block.

Where can we get one of the lists, so we can tell whom *not* to take the trouble to look up? MERIDEN MACHINE TOOL CO.

Below we publish the list from the columns of our contemporary *Dixie*. It will be noticed that the concern mentioned in the letter of the Hendey Machine Co. does not appear in this official list, though the information obtained by the Hendey Machine Co. shows that it should be included and illustrates the force of what we first said, *i. e.*, that there were probably many swindlers in Amsterdam not on this list, and that it therefore behooves those who may receive orders from them to "go slow," even if the name of the correspondent does not appear there. It would seem as though it would be to the interest of the honest merchants of Amsterdam and of that city's reputation if the police who know enough of these concerns to justify the publication of their names as swindlers were required to take steps to suppress them. But, perhaps, this is only a theory that cannot be reduced to practice in Amsterdam more than in New York or Chicago:

CHIEF BUREAU OF POLICE.
(*Detective Service.*)

LIST OF DOUBTFUL MERCHANTS AND SWINDLERS AT AMSTERDAM, HOLLAND.

C. G. Demkes & J. van den Bergh, A. Oosterwerf, J. van der Markt & Co., Douwe van der Kamp, Issers de Vries & Co., Wesselink & Co., L. Casteleijn & Co., Cornelis van den Bergh, Hoen & Co., A. Cordes & Co., M. van den Molen & Co., Van Sluisdam & Co., Ten Have & Co, Cornelis van Os, Latrine Stevens & Co., C. F. Dejong & Co., M. M. R. Greveling & Son, Charles Manie & Co., J. M. & T. M. S. Arntz, Rembrand & Co., J. J. van Aggelen, Frits Winter, G. Rigberts, Joseph Hekker, H. Schneiders & Co., Van den Bergh & Zwartjes, E. J. d'Hont, J. F. L. Muller & Co., H. F. Janson, Den Bruggen & Co., L. Beijersbergen & Co., W. J. E. Havermans & Co., Van Dormolen & Co., Hofstra & Co., Van den Bergh & Co., Holle & Co., E. Verkerk, of Verkerk & Co., Du Chatinier & Co., Kemper van Drielen & Co., Teesink & Co., Mouthaan & Co., J. De Vries, of J. Westerhoek, C. M. Hanenwinckel, Dominique Marchalle, A. Kappee & Co., Milbergh & Co., F. Nieuwenhuis & Co., Machiel van Berkel, Govers & Co., F. Fischer & Co., Kaspers & Co.

UNITED STATES CONSULATE,
AMSTERDAM, HOLLAND, July 20, 1893.

This is an official list of swindling firms here, published by the police authorities.

THEO. M. SCHLEIER, *Consul.*

The Dry Dock and Battery Railway Company Boiler Explosion.

BY ALFRED R. PAYNE.

The recent explosion of a boiler in the stable of the Dry Dock and Battery Street Railway Company, extending from East Fourteenth to East Fifteenth street, Thursday, November 2d, has caused a good deal of the usual discussion in the stationary engineers' world. The low-water theory, the gas theory, the sudden increased pressure theory, etc., etc., have all been ventilated; these ideas are generally advanced by people who, while they have been used to boilers, can fire them, and turn the steam on an engine, have never, perhaps, seen an exploded boiler before, and do not know where to look for the primary cause of such a disaster.

Fig. 3

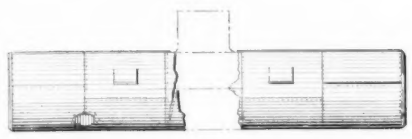


Fig. 4

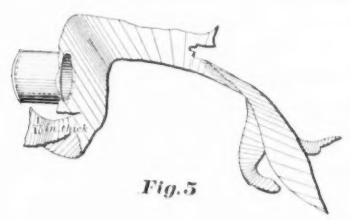


Fig. 5

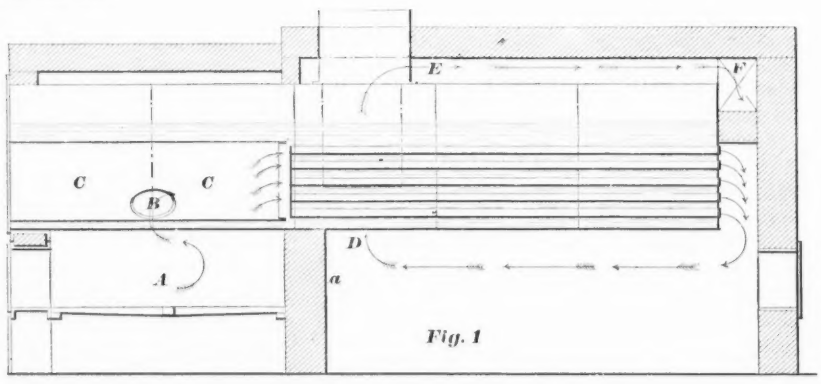


Fig. 1

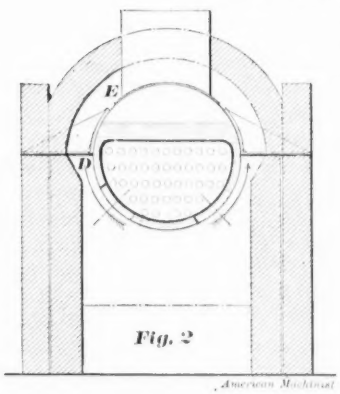


Fig. 2

American Machinist

It is necessary to be not only an engineer, and used to steam and steam boilers, but to have seen numbers of explosions, and to have inspected internally and externally numbers of boilers, in order to be able to form a correct opinion as to the cause of such a calamity.

I send herewith some sketches which, I think, will make this case plainer to those of your readers who are interested in this subject.

The boiler used, as above stated, was a "Lowe" boiler, made by Messrs. Lowe & Watson, of Bridgeport, Conn., about ten years ago. This boiler, with its peculiar setting, has a high reputation for its economical consumption of fuel. When tested at the Centennial Exposition in 1876, it was high up in the list; it is always well built, and I believe this is the first one to explode.

In Fig. 1 is shown a longitudinal section, and in Fig. 2 a cross-section of the boiler and setting.

The Lowe boiler is composed of a shell, in this case 44 inches in diameter by 18 feet 8 inches long, having an oval-shaped combustion chamber 38 inches wide by 25 inches high and 88 inches long at *C C*, into which the heated gases pass from the fire-place *A* through the flue *B*; the gases then enter the tubes (46 in number) from thence drop down and pass along the bottom of the boiler till they encounter the wall *a*, where they pass upwards through flues *D* recessed in the side walls, and turn over the top, and pass through flue *E* to chimney opening at *F*.

By thus understanding how the Lowe boiler is built and set, the reader will be able to understand the writer's idea as to the cause of this explosion.

The boiler was torn into three parts. The front portion, with two rings of sheets, was projected through the walls of the building across the street, landing against the wall of an opposite house.

The rear portion, also composed of two rings, was projected to the rear, demolishing the stable.

The central portion, composed of one ring, with the steam dome, 28 inches diameter by 24 inches high, was deposited about two-thirds of the distance from the front portion towards the rear portion.

Fig. 3 shows the boiler dotted with the course of the fractures shown in full lines.

Fig. 4 shows the front and rear portions drawn in full in their relative positions, with central part and dome dotted in.

Fig. 5 shows the central portion, with the dome attached.

It seems that the boiler must have given way first, at a little above the horizontal seam on the right side, at the point where the flue *D* would come, which took the gases up to the flue *E*.

The boiler plate at this point was by actual measurement only $\frac{1}{10}$ of an inch thick for a space measuring 17½ inches by 13½ inches. The writer pointed this out to a City Inspector, who was there when he was. He broke a piece off and took it away, but would not allow this was the cause of the trouble.

By examining the construction and setting of this boiler, it will be seen that the gases in their upward course pass through a contracted flue or flues over a large surface of plates which has no water against it, but only steam; the wear on this must be greater than on surfaces where water is in contact, and it would seem that this thinning or cutting action was increasing day by day during the years of service, until the plate at $\frac{1}{10}$ of an inch in thickness would no longer sustain the ordinary pressure, and gave way. In such cases when a rupture occurs of such length, it is easy to account for the boiler tearing in twain along the seams; and the issuing contents of steam and superheated water (at 340°), which turns into steam just like gunpowder, would force the two larger portions of the boiler in opposite directions, leaving the middle portion, which would first lose its propelling force, midway between them.

I have during 25 years' experience as boiler inspector, engineer and expert, visited the scenes of about 300 boiler explosions, many of them occurring from a like cause. I have also the records, with cuts, of thousands of explosions—all can be traced readily to causes which would have been discovered by a periodical examination by what is called the "hammer test," to distinguish it from the inspection which might be called "the pump strain." If this boiler had been examined properly, in the only rational way, lives might have been saved.

Practical Co-operation.

According to a correspondent of *The Evening Post* the Nye & Wait Carpet Works issued the following appeal to their workmen early in October. We hope the firm was met half way by its operatives:

On account of the general business depression, and the decline in the value of all kinds of goods, manufacturers everywhere are reducing wages. We believe this can be avoided in our factory, if all work shoulder to shoulder; at least we are willing to try the experiment, if you will try with us. In order for us to do our part, it is necessary that we should have perfectly woven cloth, good colors, and yarn well spun, twisted and wound, and that every one should make an extra effort to do a little more work to increase production, in order to lessen the cost of our goods. Waste of all kinds should be stopped. All we ask is for every one to do his best while the present depression lasts, and we will continue to pay the present rate of wages so long as it is possible to do so and run without too great a loss.

THE NYE & WAIT CARPET COMPANY.
Auburn, October 7.

In the way of discussion, Vosper & Co., of Portsmouth, England, give *The Engineer* the following figures as to weight and fuel used in one of their oil engines:

"We have pleasure in giving your readers the actual result of a trial just made of one of our No. 5 size of oil engines. The engine commenced running in nine minutes after the lamp was lighted from the cold, and ran continuously for three hours on a consumption of 2.75 gallons of oil for the whole of the three hours' run. The engine gave out just over 6½ brake horse-power, which means that it will develop quite 11 indicated horse-power after having been thoroughly well run, as it is now quite new and stiff. The engine was weighed just as it was on this trial, the weight with oil in crank box, reversing box, and with intermediate shaft, thrust bearing, naval brass shaft 1⅞ inches diameter, stern tube, and gun-metal propeller, all complete being 12 cwt. 2 qr.; add ten hours' supply of oil and tank, 3 qr. 20 pounds; total, 13 cwt. 1 qr. 20 pounds. Now, this total weight, even though inclusive, as it is, of the oil and tank, still comes within our previous figures of 137 pounds per indicated horse-power, and this size of engine will drive a boat 30 feet long by 6 feet 10 inches beam at a speed of 6¼ knots per hour for ten hours' continuous running. Will a steam engine and boiler, with fuel, only weighing same as the above, do this?"

Another correspondent, writing under similar circumstances, says:

"The weight of the single-cylinder three brake horse-power Roots' oil engine is 2 cwt. 3 qr. 5 pounds. The indicated horse-power of this engine would be about 3¾. The consumption of oil one pint per brake horse-power per hour at maximum power. This is American oil, for which I have had a quotation of 4¼d. per gallon by the barrel, but which I understand can be obtained cheaper. It would be necessary to carry for a ten hours' run four gallons and one pint."

During some recent tests of a Brown wire wound gun at Sandy Hook a breech pressure was recorded of 53,500 pounds per square inch. The gun was a 5-inch caliber, the shot weighed 60½ pounds, and there was 30 pounds of Leonard smokeless powder. It is said that the pressure named is without precedent for similar conditions.

The process for solidifying petroleum comes up with a good deal of regularity about once in ten years, always as something quite new. This time "the secret of the process is now believed to be on its way to this country," the inventor refusing to patent it, but proposing to sell the secret.

AMERICAN MACHINIST

Communications relating to the reading columns should be addressed to the Editor. All other communications should be addressed:

AMERICAN MACHINIST,
203 BROADWAY, NEW YORK.

PUBLISHED WEEKLY AT
203 Broadway, New York.

HORACE B. MILLER, Pres't and Bus. Manager.
LYCURGUS B. MOORE, Treas. and Sec'y.

F. F. HEMENWAY, Editor and Mech. Engineer.
J. G. A. MEYER, } Associates.
FRED J. MILLER, }

Special Announcements.

☞ *Positively we will neither publish anything in our reading columns for pay or in consideration of advertising patronage. Those who wish to recommend their wares to our readers can do so as fully as they choose in our advertising columns, but our editorial opinions are not for sale.*

☞ *Every correspondent, in order to insure attention, should give his full name and address, not for publication, but as a guarantee of good faith.*

☞ *We are not engaged in procuring patent rights, or in selling machinery, nor have we any pet scheme to advance, or hobby to ride.*

☞ *We invite correspondence from practical machinists, engineers, inventors, draftsmen, and all those specially interested in the occupations we represent, on subjects pertaining to machinery.*

☞ *Subscribers can have the mailing address of their paper changed as often as they desire. Send both old and new addresses. Those who fail to receive their papers promptly will please notify us at once. Date on wrapper denotes week with which subscription expires.*

Subscription.

$3.00 a year in advance, postage prepaid, in the United States, Canada, and Mexico.
$4.00 a year to Other Countries, postage prepaid.

Advertising.

Transient, 35c. per line, each insertion.
"Business Specials," 50c. a line.

The American News Company,
Publishers' Agents, New York.
DEALERS SUPPLIED BY

The Albany News Company, Albany, N. Y.
The American News Company, New York, N. Y.
The Baltimore News Company, Baltimore, Md.
The Brooklyn News Company, Brooklyn, N. Y.
The Buffalo News Co., Buffalo, N. Y.
The Central News Company, Philadelphia, Pa.
The Cincinnati News Company, Cincinnati, Ohio.
The Cleveland News Company, Cleveland, Ohio.
The Colorado News Company, Denver, Colorado.
The Detroit News Company, Detroit, Mich.
The International News Company, New York, N. Y.
The Minnesota News Company, St. Paul, Minn.
The Montreal News Company, Montreal, Canada.
The National News Company, New York, N. Y.
The Newark News Company, Newark, N. J.
The New England News Company, Boston, Mass.
The New Orleans News Company, New Orleans, La.
The New York News Company, New York, N. Y.
The Northern News Company, Troy, New York.
The Omaha News Company, Omaha, Neb.
The Pittsburgh News Company, Pittsburgh, Pa.
The Rhode Island News Company, Providence, R. I.
The San Francisco News Co., San Francisco, Cal.
The South West News Company, Kansas City, Mo.
The St. Louis News Company, St. Louis, Mo.
The Toronto News Co., Toronto, Ontario, Canada.
The Union News Company, New York, N. Y.
The Washington News Company, Washington, D. C.
The Western News Company, Chicago, Ill.
The Williamsburgh News Co., Brooklyn, E. D., N. Y.
The Wisconsin News Company, Milwaukee, Wis.

The International News Company,
BREAM'S BLDG'S, Chancery Lane, LONDON, E. C., ENG., or Stefanstrasse 18, LEIPZIG, GERMANY, will receive subscriptions for the AMERICAN MACHINIST, at 16/6 per annum, English currency, or 17 marks per annum, German currency, postpaid.

Subscriptions received in Paris, France, by E. TERQUEM, 31 Boulevard Hausmann, at 20 francs per annum, postpaid.

Subscriptions received in Australia by W. WILLIAMS, 17 and 21 Fink's Buildings, Melbourne.

NEW YORK, NOVEMBER 16, 1893.

CONTENTS.

	PAGE.
A New Rotary Positive Blower	1
Automatic Mortising Machine	1
A Brass Furnace. By Isaac Whitehead	2
Steam Power and Electricity in Switzerland. By J. C. Monaghan, Consul	2
Entering the Winter with Rolling Stock Run Down	2
Columbian Exposition Notes. By F. J. M	3, 4
New Process of Cutting Cams	4, 5, 6
Letters from Practical Men: High Tensile Strength of Bronze Castings. By "Console Bronze"....."Cheap Imitations." By R. S. W. ... Mysterious Causes of Mail Losses. By S. W. Balch....West's Cupola. By T. Beverley Keim	6
The Amsterdam Rascals. By Bement, Miles & Co	6, 7
The Dry Dock and Battery Railway Company Boiler Explosion. By Alfred R. Payne	7
Our Unstable Vessels—Metacentric Heights	8
A Lesson of the Fair	8
A Socialistic Attack	8
Literary Notes	8, 9
Questions and Answers	9
Arithmetic of the Screw and of Symmetrical Rings—I. By Leicester Allen	10
New Felloe Boring Machine	10
New Double Crank Stamping Press	10, 11
Gas Engines. By W. H. Booth	11, 12
Manufactures	12, 13
Machinists' Supplies and Iron	13

Our Unstable Vessels—Metacentric Height.

It must be somewhat humiliating to those who have been indulging in extravagant boasting about our new naval vessels to find now that a number of the newest ones have such a small metacentric height as to make them far more dangerous to those who go to sea in them than to our enemies, that is, supposing we were to have any enemies.

At this writing we are unable to state just who will finally be blamed for the mistakes in construction though this matter is supposed to be in process of investigation by a specially appointed board of experts, so that some time, we may hope, we shall be enlightened on this point. So far one bureau and one official after another has succeeded apparently in proving that "it wasn't me," and about the only facts that seem clear are that several of our newest vessels must be considerably lightened above, or heavily ballasted, perhaps both, on penalty of probably "turning turtle," and drowning everybody aboard in the first rough sea they may encounter.

The metacenter of a vessel, it may be explained for the benefit of those of our readers who are not familiar with nautical terms, is that point in a vessel at which an upward thrust might be supposed to be concentrated which would equal in amount and effect the upward thrust of the water when the vessel is rotated from side to side, or heeled, first one way and then the other. This point is always in the vertical center line of the vessel and vertically over the center of buoyancy, or, in other words, vertically over the center of gravity of the body of water displaced in any position of the ship whether on an even keel or otherwise. It is this upward thrust of the water acting at one end of a lever, and the downward moment acting at the center of gravity of the ship that tend to right it when heeled, the length of the lever upon which these forces act being represented by the horizontal distance from the center of gravity of the ship to the center of gravity of the body of water displaced by it.

It is, therefore, the height of the metacenter above the center of gravity of the ship that determines its stability. The less the metacentric height the greater the amplitude and the slower the rolling motion of the ship; a metacentric height of 0 meaning that the ship would have no tendency to right herself, while a metacentric height of less than 0 would give a condition in which the vessel would by preference float (or sink) bottom upwards. In some of the new war vessels the metacentric height is apparently about as many inches as it should be feet, and in general it may be said that this is probably due to a desire upon the part of some one to burden them with the heaviest and greatest possible number of guns. Something has been said about excess weight in engines, but this, we think, will turn out to be scarcely worth mentioning, especially since such excess weight as may occur in the equipment of the engine department is quite likely to be so low as to increase metacentric height and stability rather than otherwise.

A Lesson of the Fair.

It is not possible that a great international exposition like the one just closed at Chicago shall have passed without those of different countries represented there having learned more respect for the industrial abilities of their respective countries. By turns each country in the past has been given the palm for boasting, and the fact seems to be that boasting is a rather universal habit amongst those of all nationalities, only it is done in different ways, according to temperament, surroundings, and early education. But it hardly seems probable that it will be quite so freely indulged in, for a few years at least, as before the Fair. The unprejudiced mind is rather likely to have gathered in the idea that in some special direction each nation excels, and that is a pretty good idea to get hold of. No nation can set itself up as the great exemplar in all, or more than a very few directions. In some special direction the superior skill of the designer and the artisan came easily enough to the front in the instance of every important country represented at Chicago. There is nothing of either pride or humiliation in this. It simply shows how near akin the human race, in a highly civilized state, really is; this and the dependence of one country upon other countries if the best efforts of civilization are made available.

If there is a difference, as by countries, in respect to boasting, we are inclined to believe that the two great English speaking nations are in the lead. In fact we think there is a difference, and that these two nations are easily enough in the lead, without any choice, between them in this respect. The elder, through more years of experience, may have reduced the matter to a little nearer the condition of a science; that is all the difference likely to be seen. Each is given to accusing the other of being the chief sinner in this respect, which is only another form of bragging. Each had, we think, excellent opportunities of learning a lesson in consistent humility at Chicago. Both ought to profit by the lesson, which will undoubtedly be the case.

A Socialist Attack.

A publication called *The People* undertakes to annihilate us for saying that electric motors should displace steam locomotives only when shown to be economically superior. *The People* is a socialistic publication apparently, and its silly attack upon us, so far as it has any meaning at all, consists in the charge that the AMERICAN MACHINIST is a "bosses' organ," a very cheap but favorite form of argument with those whose position can be defended upon no logical or reasonable ground.

The body of socialists seems to be made up of two classes of people. First those who are abundantly able to take care of themselves, but who, seeing the misery and suffering in the world, deeply sympathize with it, not more than some of the rest of us perhaps, but at any rate without thinking further than that it can be and ought to be relieved by removing competition and securing for everybody an equal share in the results of the world's work; the kindness of heart of these people not only making them willing to share the results of their labor with those less able or less industrious, but blinding them to every other consideration. The other class of socialists are those who for one reason and another are more or less failures in life and without much reasoning on the matter are simply ready to embrace any theory that promises or pretends that it will relieve them of the necessity of competing with their more able or more industrious fellow-men. Both these classes pity, or vigorously condemn those who differ from them in opinion, the less intelligent resorting to irrelevant, abusive and untrue statements, as noted above, when other arguments fail them.

We have other business than to waste our time and space in noticing these vaporings, but it may be worth while to say that we believe that if oppressive monopolies were abolished, and every man given an opportunity to fully employ such talents and abilities as nature has given him, there would then be no serious suffering from poverty other than that resulting from personal and inexcusable folly, and we believe that with freedom from such oppressive monopolies, competition instead of being the awful thing imagined by the socialists, will prove the most beneficent of social forces.

Whether we are a bosses' organ or the workingmen's organ (we have been accused of both) this is our belief, and with this statement of it we leave the subject.

We daily see accounts of men, some of them graduates of Annapolis, enlisting in the service of the Brazilian Government to help put down the rebellion in that country. Conflicting stories make it impossible to judge of its merits, though it seems likely there is more or less good ground for dissatisfaction there; but whether there is justification for Admiral Mello's position or not the enlistment of Americans for the work of doing it will inevitably remind one of the Hessian soldiers that once helped in an effort to put down a rebellion on this continent, not from patriotic or any other motives that are supposed to justify the attempts of men to kill other men, but for hire. Making all due allowance for difference of conditions, should we not either keep clear of wars in other countries or stop heaping obloquy upon the memory of the "hired Hessians"?

Prof. F. R Honey calls our attention to the fact that in issue of September 21st an article, entitled "The Change from Gas to Liquid," was published under his name as author, an article which he did not write. The article in question was written by Prof. Jos. Torrey, but was credited to Professor Honey by mistake.

Literary Notes.

THE LOCOMOTIVE CATECHISM, containing nearly 1,300 questions and answers concerning designing and constructing, repairing and running various kinds of locomotive engines. Intended as examination questions, and to post and remind the engine runner, fireman and learner. By Robert Grimshaw, M. E., author of numerous other practical works.

The scope of the work is well indicated on the title page as quoted above. The character of the questions is such as to attract the interest of the reader, and many of the answers will convey correct and useful information. But unfortunately there are answers which indicate a want of care and thought, and consequently contain errors and misleading statements which will tend to lessen the confidence of the reader in the educational character of the work. For instance on page 145 we are informed that the lead varies with the shifting link; this is correct; on page 147 we are informed that, "either at or near the center of the link-slot, or at mid-gear, the block will have no motion either way no matter which way the eccentrics run." Now these two statements are contradictory, for how can the lead vary if the link-block and, consequently, the valve do not move in mid-gear? The truth of the matter is, that the link-block and, consequently, the valve do move in mid-gear, and that lead in mid-gear is greater than in full gear, in all cases where the Stephenson link is used. Of course the eccentric rods can be connected to the link in a manner so as to have no lead in mid-gear, but such an arrangement is not generally admissible in locomotive construction. On page 143 we are informed that "the irregularity of cut-off, caused by the angularity of the connecting rod, can be done away with by giving the valve more lap upon that end at which the cut off would be the earliest if the laps were the same at both ends of the valve." This is true as far as it goes; but it is misleading without any qualifications in a book treating on the construction of locomotives, as the reader may be led to infer that this method is adopted for equalizing the cut-off in locomotives. In these engines, with Stephenson's link, the cut off is equalized by moving the saddle-pin a suitable distance towards the eccentrics, locating the lifting shaft correctly and giving the lifting shaft arms a length suitable for the object sought. Again, on page 171 we are informed that "the eccentrics for a lapless valve should be run back of the crank-pin (in the opposite direction from that in which it is required to run the engine) 90 degrees." There are very few locomotives whose eccentrics could be set at 90 degrees from the center line of crank under the given condition, and should this occur it would be a mere matter of coincidence. The position of the eccentrics relative to that of the crank will depend on the relative positions of axle, cylinder and valve gear; designers pay but very little attention, if any, to the angle of advance measured from the center line of crank.

Before this work can be ranked with standard works, it will require thorough

revision and correction. From a typographical standpoint, the book is well gotten up. It is published by Norman W. Henley & Co., 150 Nassau street, New York. Price $2.

QUESTIONS AND ANSWERS.

Questions of general interest relating to subjects discussed in our columns will receive attention in this department. The writer's name and address should always accompany the question. Neither correct initials nor location will be published when there is a request to that effect. If questions are enclosed with a business communication, they should be written on a separate sheet.

(556) Will U. A., Wilmington, Del., Question 537, send us his address? We have a communication for him.

(557) E. D., Lemont, Ill., asks: What is the best method of polishing fine steel dies? And which is the best compound powder to use for this purpose? The dies I wish to polish are for striking out medals of aluminum. *A.*—Fine emery is best suited for polishing the dies; if this does not give a polish sufficiently fine, stoning and burnishing will have to be resorted to.

(558) U. S. D., Reading, Pa., writes: I have seen in one of your issues the standard section lining for different metals, but I did not take care of the number; now I want it. Please give date of issue, and state if I can get this number if it is not among my file? *A.*—The standard section lining, adopted at Sibley College, Cornell University, is shown in our issue of April 9, 1887. We can furnish that number at any time you may send for it.

(559) R. D., Cleveland, O., writes: Kindly inform me of the nearest college to this city where a young man serving his apprenticeship in a machine shop can take a course of engineering? *A.*—There are two technical institutions in your city, Case School of Applied Science, and the University of Cincinnati; send your application to either one. 2. Which in your opinion is preferable, civil, or mechanical engineering? *A.*—Choose that branch for which your ability and tastes are best adapted. 3. What books should I study during the remainder of my apprenticeship to prepare for admission? *A.*—See article treating on "What to Study and How to Study," in our issue of February 19, 1891.

(560) J. D. P., York, Pa., writes: Inclosed I send you blue-prints of two horizontal boiler settings; kindly give me your opinion which of the two is preferable. In the setting marked *A* the distance from the bottom of the boiler to top of bridge wall is 10 inches, and this distance is increased to 24 inches at the rear end of the boiler. In the setting *B* the distance from the bottom of the boiler to top of bridge wall is 16 inches, and this distance is decreased to 10 inches at the rear end of the boiler. The question is, which is the best way of handling the gases, after they pass over the bridge wall; whether to let them pass as free as possible, as shown in *A*, or to retard them slightly before passing through the return flues, as shown in *B*? *A.*—The passage for the gases should not be contracted towards the rear end of the boiler, but should be enlarged as shown in *A*, which is the best setting.

(561) J. C. B., Brooklyn, N. Y., writes: I have been trying to tin small iron castings, but can make nothing of it compared with work I see daily. I have experimented in every way that I know of, but have not obtained satisfactory results. The castings have a gritty appearance, and are not bright and perfectly smooth. Kindly help me out of the difficulty. *A.*—Cleanse the castings by immersing them in an acid solution; for new metal this solution should be sulphuric acid and water (about 1 to 20 of water), but for old metal, muriatic acid and water; next scour with sand, and cleanse well with water. For tinning put the castings in a bath of one ounce cream of tartar, one ounce tin salt, and ten quarts of water. The bath should be kept at a temperature of 190° Fahr., in a stone vessel. Put pieces of zinc between the articles. When the coat of tin is considered thick enough, take the articles out of the fluid, wash them with water and dry them.

(562) W. A. F., Appleton, Wis., writes: Please let me know what a steam loop is. *A.*—A steam loop is simply a method of piping by which water of condensation is returned to steam boilers. In its simplest form it consists of three pipes, which are called the riser, the horizontal and the drop leg. When the steam loop is used for returning to the boiler, the water of condensation and entrainment from the steam pipe through which the steam flows to the cylinder of an engine, the riser is generally attached to a separator; this riser empties at a suitable height into the horizontal, and from thence the water of condensation is led into the drop leg which is connected to the boiler, into which the water of condensation is fed as soon as the hydrostatic pressure in drop leg in connection with the steam pressure in the pipes is sufficient to overcome the boiler pressure. The action of the device depends on the following principles: Difference of pressure may be balanced by a water column; vapors or liquids tend to flow to the point of lowest pressure; rate of flow depends on difference of pressure and mass; decrease of static pressure in a steam pipe or chamber is proportional to rate of condensation; in a steam current water will be carried or swept along rapidly by friction. 2. Did you ever publish articles treating on this subject? If not from where could I obtain a book, suitable for a practical man, which describes the steam loop? *A.*—We have not published any articles relating to this subject, but there is a pamphlet published which will give you the desired information. This pamphlet you can obtain by writing to Westinghouse, Church, Kerr & Co., Engineers, 17 Cortlandt street, New York.

(563) R. B. E., Wellsville, N. Y., asks: Can formulas for computing the extension of helical springs be used for computing the compression of the same springs? *A.*—Yes. 2. Please give formula and example. *A.*—The formula we have been accustomed to use is

$$E = \frac{d^3 \times w}{C \times D^4},$$

in which E denotes the compression or extension of one coil in inches; d the mean diameter, or the diameter from center to center of steel bar of which the spring is made; w the weight applied in pounds; D the diameter, or side of square of the steel bar in sixteenths of an inch; C a constant which may be taken as 22 for round steel, and 30 for square steel. To show the application of this formula, let it be required to find the deflection of a helical spring $2\frac{1}{2}$ inches in diameter; diameter of steel, $\frac{1}{2}$ inch; load, 1,400 pounds. Here, the mean diameter $d = 2\frac{1}{2} - \frac{1}{2} = 2$ inches; now replacing the symbols by their values we have

$$E = \frac{2^3 \times 1{,}400}{22 \times 8^4} = 0.124 \text{ of an inch}$$

deflection for one coil; multiplying this by the number of coils, we obtain the total deflection of the spring. This deflection may be affected by the quality of the steel, but it will not vary much from the above results. For very accurate computations, we should know the modulus of elasticity of the particular kind of steel used. Formulas into which this modulus of elasticity enters are given in our issue of August 18, 1892. 3. Are not compression springs less liable to break than extension springs? If so, why are they not used to a greater extent in automatic engines? *A.*—Compression springs are not less liable to break than extension springs. The reason why the former are not used to a greater extent in automatic cut-off engines is, that usually springs of a considerable length are required, and when these are subjected to compression they are liable to buckle.

(564) F. E. B., San Francisco, Cal., writes: Kindly let me know the shortest and most exact rule for finding the mean effective pressure in a compound steam engine? *A.*—We presume you wish to know how to find the mean effective pressure which is used for making the first approximations of the horse-power of a compound engine. In cases of this kind it is customary to assume that the total number of expansions occur in the low-pressure cylinder, or in the cylinders that exhaust into the atmosphere or condenser, and it is assumed that the expansion curve is a rectangular hyperbola. The number of expansions in the small or high-pressure cylinder is found by dividing the stroke in inches by the distance in inches from the beginning of the stroke up to the point of cut off. If, for instance, the stroke is 24 inches, and steam is cut off at 8 inches, then the number of expansions in the high-pressure cylinder will be $\frac{24}{8} = 3$. The total number of expansions are found by multiplying the number of expansions in the high-pressure cylinder by the ratio of the volumes of the high and low-pressure cylinders. If, for instance, this ratio is 4, and the number of expansions in the high-pressure cylinder is 3, then the total number of expansions will be $3 \times 4 = 12$. Now, to compute the mean effective pressure of a compound engine, find the hyperbolic logarithm of the total number of expansions and add 1, divide this sum by the total number of expansions, multiply the quotient by the absolute initial pressure in the high-pressure cylinder, and subtract the mean absolute back pressure. If, for instance, the total number of expansions is 12, the absolute initial pressure 90 pounds, and the absolute back pressure 4 pounds, then the mean effective pressure is found as follows: The hyperbolic logarithm of 12 is 2.485, hence we have,

$$\frac{1 + 2.485}{12} \times 90 = 26.10 \text{ pounds};$$

subtracting from this the back pressure, we have $26.10 - 4 = 22.10$ pounds mean effective pressure.

(565) F. R., New York, draws our attention to an error in answer to Question 540; we thank him for doing so. In the foregoing answer we stated that the air compressor having an air cylinder 20 inches diameter, 15 inches stroke, will deliver, when running at the rate of 160 strokes per minute, 81 cubic feet of air per minute at a pressure of 80 pounds. This amount is too great; it should have been 60 87 cubic feet per minute; multiplying this by 1.25779, as we did before, we have $60\ 87 \times 1\ 25779 = 76\ 56$ horse-power for running the air compressor. Nothing should be added to this for friction, as allowance for friction has been made in the factor 1 25779. The number of cubic feet per minute at 80 lbs. pressure which the air cylinder can deliver is found as follows: We first compute the free air capacity of the cylinder by multiplying the area of the piston in square inches by the stroke in feet and by the number of strokes per minute, and dividing this product by 144. According to this we have

$$\frac{20^2 \times .7854 \times \frac{5}{4} \times 160}{144} = 436.33$$

cubic feet; subtracting from this a loss of 10 per cent. we have 392.7 cubic feet of air at a pressure of one atmosphere. At 80 pounds gauge pressure, or 94.7 pounds absolute pressure, the air at constant temperature will occupy $\frac{14.7}{94\ 7} = .155$ times its volume that it occupied under the pressure of one atmosphere. (The decimal .155 can at once be obtained by referring to the table on page 10 in our issue of March 23d, current volume.) Hence the volume of air delivered per minute under the given pressure will be $392\ 7 \times .155 = 60\ 87$ cubic feet. From the foregoing it will be seen that when the number of cubic feet of air under a given pressure to be delivered per minute are known, the horse-power is readily computed by multiplying this number by the factor corresponding to the given pressure given in column 2 in the second table on page 7 in our issue of March 30th, current volume. The same result can be obtained by multiplying the free air capacity of the cylinder by the factor corresponding to the given pressure at which the air is to be delivered, as given in column 2 in the first table given on the same page as above referred to. For instance, we found that the free air capacity of the cylinder with a deduction of 10 per cent is $392\ 7$ cubic feet. The factor corresponding to 80 pounds gauge pressure given in column 2 of the first table is .19521, hence we have $392.7 \times .19521 = 76\ 65$ horse-power. If these tables are not at hand, the horse power can be found in manner precisely similar to that of finding the horse power of a steam engine, namely, multiply the area of the piston in square inches by the mean effective pressure, which in this case is equal to the mean resistance, by the piston speed in feet per minute, and divide this product by 33 000, the result will be the required horse-power. The mean resistance in this case is 36.6 pounds per square inch of piston, hence we have

$$\frac{20^2 \times .7854 \times 36\ 6 \times \frac{5}{4} \times 160}{33{,}000} = 69.68$$

horse-power. To this should be added 10 per cent. for friction, which will give us 76.64 horse-power for running the air compressor. Since we published our last answer we have been informed that an allowance of 10 per cent. for friction of the air compressor is sufficient, hence our allowance of 10 per cent. instead of 20 per cent. The mean resistance per square inch of piston is found in the table on page 10, March 23d, current volume.

(566) T Square, ——, writes: Kindly furnish information relating to the following problem. What should be the curve for cams on locomotive driver brakes, as shown in the accompanying sketch, so that with a constant piston pressure a uniform pressure would be produced by the brake shoe against the tire? Give a practical method for laying out such a curve with a given travel of piston and a given movement of shoe? *A.*—In Fig. 2 the principles involved in laying out this curve are shown, and in order to show these clearly the center lines are not drawn at distances proportional to those in Fig. 1; similar letters in both figures indicate similar lines and points. The hanger M will cause the center C in Fig. 1 to move in an arc, but for the comparatively short distance through which this point has to move, the direction of this curve will not differ much from the straight line $A\ B$; hence we shall assume that the point of contact will always lie in the center line $L\ H$ and that the point C travels in the line $A\ B$. Let the point x in Fig. 2 be the lowest point of contact between the two curves, and the point c the corresponding position of the center of the pin through the opposite end of the rod N; through c and x draw the line $c\ x$ making an angle a with the line $A\ H$. Now, for a uniform pressure of the brake shoe against the tire, the lines drawn from any point x^0 of contact between the two curves to the corresponding center c^0 must make the same angle a with the line $A\ H$. Let $c\ c^3$ be the total movement of the center c on the line $A\ H$; divide this distance

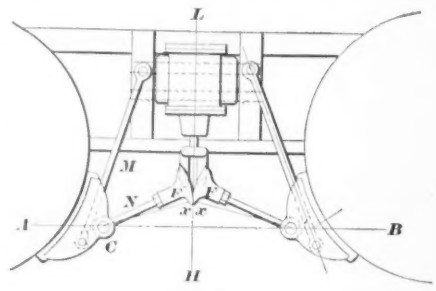


Fig. 1

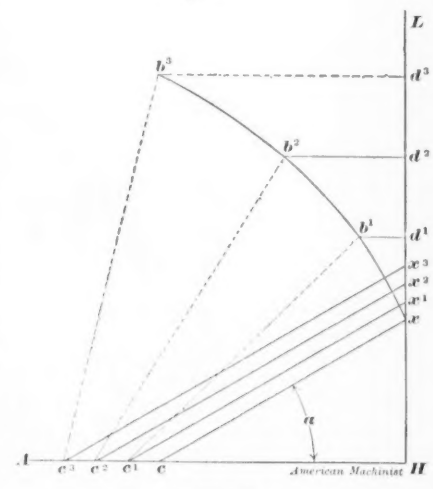


Fig. 2

into any number of equal parts, say 3, and thus obtain the points c^1, c^2. Let $x\ d^3$ on the line $L\ H$ represent the total movement of the piston; divide this distance into three equal parts thereby obtaining the points d^1 and d^2. Through d^1, d^2 and d^3 draw horizontal lines $d^1\ b^1$, $d^2\ b^2$ and $d^3\ b^3$ and through the points c^1, c^2 and c^3 draw lines parallel to $c\ x$, cutting the line $L\ H$ in the points x^1, x^2 and x^3. From c^1 as a center and $c^1\ x^1$ as a radius describe an arc cutting $d^1\ b^1$ in b^1; from c^2 as a center and a radius $c^2\ x^2$ describe an arc cutting $d^2\ b^2$ in the point b^2; and lastly from c^3 as a center and with a radius $c^3\ x^3$ draw an arc cutting $d^3\ b^3$ in the point b^3. A curve drawn through the points x, b^1, b^2 and b^3 will be the required curve.

BUSINESS SPECIALS

Transient Advertisements 50 cents a line for each insertion under this head. About seven words make a line. Copy should be sent to reach us not later than Saturday morning for the ensuing week's issue.

Grant's Gears, Lex'n, Mass., & Phila., Pa. See p. 12.

Forming Lathes Mer. Mach. Tool Co., Meriden, Ct.

Milling Machs. Kempsmith M. T. Co., Mill., Wis.

Pattern and Brand Letters. A variety of sizes and styles. Heber Wells, 8 Spruce St., New York.

Davis Key Seating Machines kept in stock by Manning, Maxwell & Moore, 111 Liberty St., N. Y.

Selden Packing for stuffing box, with or without rubber core. Randolph Brandt, 38 Cortlandt St., N. Y.

Pulley lathes, most efficient offered. The Lodge & Shipley Machine Tool Co., Cincinnati, O.

Steam Pressure Regulators, Reducing Valves, Safety Checks. Foster Engineer'g Co., Newark, N. J.

For the best and cheapest packing rings, address J. H. Dunbar, Youngstown, Ohio.

Guild & Garrison, Brooklyn, N. Y., manufacture steam pumps, vacuum pumps, vacuum apparatus, air pumps, acid blowers, filter press pumps, etc.

Improved Duplex and Special Gear Cutters in stock and to order; Gear and Milling Cu ters of all descriptions. R. M. Clough, Tolland, Conn.

"Pumping Machinery." New book, 450 pp. 8vo, 270 Eng. Prospectus free. W. M. Barr, 3223 Powelton Avenue, Philadelphia, Pa.

New Jersey Art Metal Co., Passaic, N. J., finest thin and ornamental castings in brass, bronze, aluminum, etc; machinery name plates in brass and aluminum.

"Binders" for the AMERICAN MACHINIST. Two styles, the "Common Sense," as heretofore sold by us and mailed to any address at $1.00 each, and the "New Handy," mailed at 50c. each. The former has stiff board covers, while the latter has flexible covers with full page opening flat. Either will hold the entire 52 issues of any volume. AMERICAN MACHINIST PUBLISHING CO. 203 Broadway, New York.

"Indicator Practice and Steam Engine Economy." By F. F. Hemenway. Contains plain directions for using the indicator and making all required calculations from the diagram, also the principles of economy in operating steam engines and current practice in testing engines and boilers. Price, $2 postpaid. Published by John Wiley & Sons, 53 East Tenth Street, New York.

Arithmetic of the Screw and of Symmetrical Rings—I.

By Leicester Allen.

A set of simple rules pertaining to mensuration of screws and rings may be of use to mechanics, if both easy to apply and accurate. Some which I have seen published are only rudely approximate, and, as to rings, the common works on mensuration seem to ignore those having any other cross-section than a circle or a rectangle. The study of rings and solids of helical form is an excellent exercise in practical mensuration, as the principles involved are capable of extension to a good deal of work that comes to the hands of draftsmen and engineers.

In designing machinery the measurement of the volumes of threads and interspaces becomes necessary in computing, before construction, the weight of large screws, for computing the delivery of screw conveyers in mill wrighting, the calculation of capacity for grain meters constructed on the principle of the screw, and for other purposes not necessary to name.

The study will also place at the ready command of those who wish to perfect themselves in methods of mensuration, principles applicable not only to special computations herein comprised, but to other calculations sometimes required in designing and constructing machinery.

If a cylinder be cut by planes or by curved or warped surfaces, and if the cutting planes or surfaces be equidistant, each from an adjacent one, at all points corresponding in position, or if the cutting surfaces be parallel with each other, the cubic contents of the several parts will be to each other as their respective thicknesses.

Thus, in Fig. 1, is shown a cylinder cut by equidistant concave surfaces into concavo-convex parts, and in Fig. 2 a cylinder is shown as cut by oblique planes parallel to each other. The parts A, B and C, Fig. 2, each being of the same thickness, either as measured on the line a f, or on a perpendicular to the cutting planes, these parts have equal cubic contents. The section D measured correspondingly on either of the lines specified, being twice the thickness of A or B or C, has twice the cubic content of either of the last-named parts; or if a b, b c, c d and d e, respectively, be taken as the thickness of the parts, then will either a b, b c or c e be to d e as either the cubic content of A, B or C is to that of D.

The part E being thinner than the part A, B or C, e f is to either a b, b c or c d as E is to either A, B or C, and e f is to d e as the content of the part E is to the content of the part D.

The wedge-shaped parts g and h, if the part g be placed on the part h, so that the thin edge of one will fall upon the thick edge of the other, will have the cubic content of a part as thick as either g or h is at the thickest portion.

In Fig. 1 a cylinder cut by concavo-convex surfaces is indicated, and the above proposition will be readily admitted to hold good for the parts of the cylinder so cut. It can also be shown to be valid for parts of a cylinder cut by a spiral or any other form of warped surfaces intersecting the cylinder in a parallel manner, that is to say, in such manner that every point in any one of two consecutive intersecting surfaces shall be equidistant from the corresponding point in the other surface.

Moreover in both figures the content of each intermediate part or slice will be the product of the area of cross-section of the cylinder multiplied into the thickness of the piece measured on a f or on any line parallel to the axis of the cylinder. Thus the part C, Fig. 1, between the planes d i and e k has the same content as though the cutting planes or surfaces were d l and e m.

If now, from any cylinder, cut as described by parallel planes or surfaces, we suppose a concentric core bored out, we shall have a hollow symmetrical cylinder cut by the same planes or surfaces, and the parts so formed will evidently have the same ratio of cubic content as the original parts had; being to each other respectively as their thicknesses; for it is a principle of geometry that if we subtract from two proportional magnitudes, respectively, two

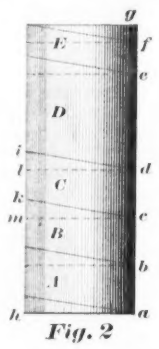


Fig. 2

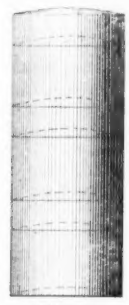


Fig. 1

Fig. 3

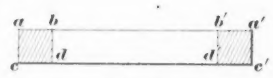


Fig. 4

Arithmetic of the Screw.

others having a like ratio, taking the smaller of the latter two from the smaller of the first two, and the larger of the latter two from the larger of the first two, the remainders will have the same ratio as the first-named two proportional quantities.

For an arithmetical illustration take the proportion

9 : 18 :: 3 : 6.

If we now subtract the ratio (3 : 6) from the first two terms of the proportion, we have the ratio (6 : 12), and putting this last ratio in the place of (3 : 6) in the proportion, we have

9 : 18 :: 6 : 12,

in which it is easily proved that the equality of the two ratios is preserved. It is upon these principles, together with others that will be stated hereafter, that the succeeding rules for the computation of the volumes of screw threads and interspaces, having any of the forms of cross-sections in use, are based.

To find the content of a single turn of the thread or of a single turn of the interspace of a screw having a thread of rectangular cross-section, Fig. 3.

Referring to Fig. 4 it is evident that if c c' be the diameter of the screw over all, and d d' the diameter of the barrel or core, the rectangles a, b, c, d and a', b', c', d' represent cross-sections of a ring, which, as has been already shown, has the same content as that of a screw thread having the same thickness, measured on a line parallel to the axis of the screw; or what is the same thing, on a line parallel to a c or a' c'.

Rule I. To find the content of a single turn of the thread or of the interspace of a screw having a rectangular cross-section.

First. Find the difference in the areas of the cross-sections of two cylinders, one having a diameter equal to that of the screw over all, the other having a diameter equal to that of the barrel or core of the screw.

Second. Multiply the difference of areas so found by the thickness of the thread measured on a line parallel to the axis of the screw; the product will be the cubic content of a single turn of the thread.

Third. Multiply the thickness of the interspace measured on a line parallel with the axis of the screw by the difference of areas; the product will be the content of a single turn of the interspace?

Example: What are the cubic contents respectively of a single turn of the thread and of the interspace of a rectangular threaded screw whose diameter over all is 8″, whose diameter of barrel is 6″, pitch $2\frac{3}{8}$″, and whose thicknesses of thread and interspace, measured on a line parallel with the axis of the screw, are, respectively, thread $1\frac{1}{4}$″, interspace $1\frac{1}{8}$″?

First Operation. Area of a circle 8″ in diameter = 50.2656 square inches. Area of a circle 6″ in diameter = 28.2744 square inches. Difference = 21.9912 square inches, say 22 square inches.

Second Operation. Difference so found multiplied by the thickness of the thread = $22 \times 1\frac{1}{4} = 27\frac{1}{2}$ cubic inches, or, written decimally, 27.5 cubic inches.

Third Operation. Difference of areas multiplied by thickness of interspace = $22 \times 1\frac{1}{8} = 24\frac{3}{4}$ cubic inches, or, written decimally, 24.75 cubic inches.

To find the *total content* of the thread or of the interspace on any screw having any form of thread, the content of a single turn of either having been determined.

Rule II. As the pitch of the screw is to its total length so is the content of a single turn of the thread to the total content thereof or of a single turn of the interspace to the total content thereof.

This rule takes into account the tapering off of the thread at each end to a thin edge when the ends are squared off in the lathe. If any portion of the tapered part be cut away allowance must be made for it.

Example: What will be the total content of the rectangular thread on a screw 12 feet long whose dimensions are otherwise like those in the previous example?

First Operation. The pitch being $2\frac{3}{8}$ inches, and the content of a single turn of the thread having been found to be 27.5 cubic inches, we have for the thread, by the rule (after reducing the length of the screw to inches), the following statement:

2 375 : 144 :: 27.5 : 1.667.4.

Hence there are 1,667.4 cubic inches in the total volume of the thread of such a screw.

Second Operation. Content of a single turn of the interspace having been found to be $24\frac{3}{4}$ cubic inches we have (replacing vulgar fractions by equivalent decimals) the proportion:

2.375 : 144 :: 24.75 : required content;

from which we find the total volume of the interspace to be 1,500.6 cubic inches.

Other forms of screw threads will be subsequently considered and special rules given therefor; such special rules being ultimately replaced by a general rule applicable to all forms of screw threads and of interspaces.

New Felloe Boring Machine.

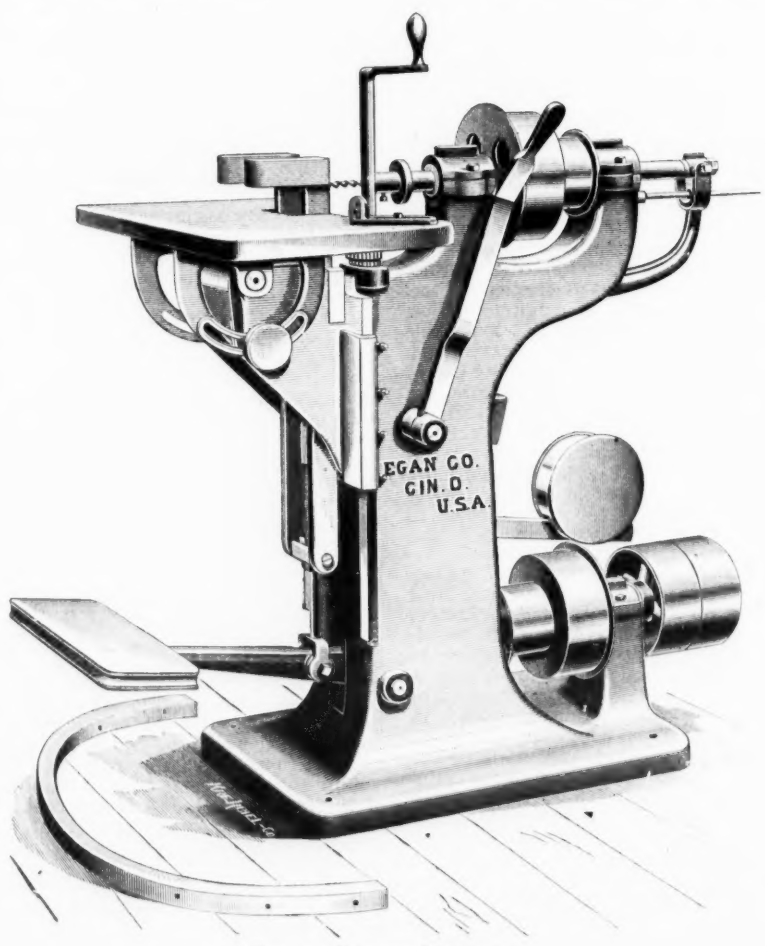
We illustrate herewith a machine designed for rapid and accurate boring of sectional or bent felloes, its general arrangement being such that, while it is especially efficient for wheel making, it is also well adapted for general boring.

The column is cast in one piece, being cored at the center. In front it has planed ways to receive the adjustable table, this being adjustable to the proper height by means of a crank handle. It is made to incline, and is held in angle position by a bolt and hand-wheel. The table can be adjusted instantly to suit bevel or straight planed felloes.

The clamping device is very simple, reliable, and powerful enough to straighten warped stock, holding the felloe down straight to the table while being bored.

The mandrel is of steel, passes through a sleeve pulley, and consequently does not come in contact with the journals, and the bit is brought forward by a lever convenient to the operator, while the felloe is clamped firmly to the table by foot-lever.

The machine is built by The Egan Co., Cincinnati, Ohio.



Felloe Boring Machine.

New Double Crank Stamping Press.

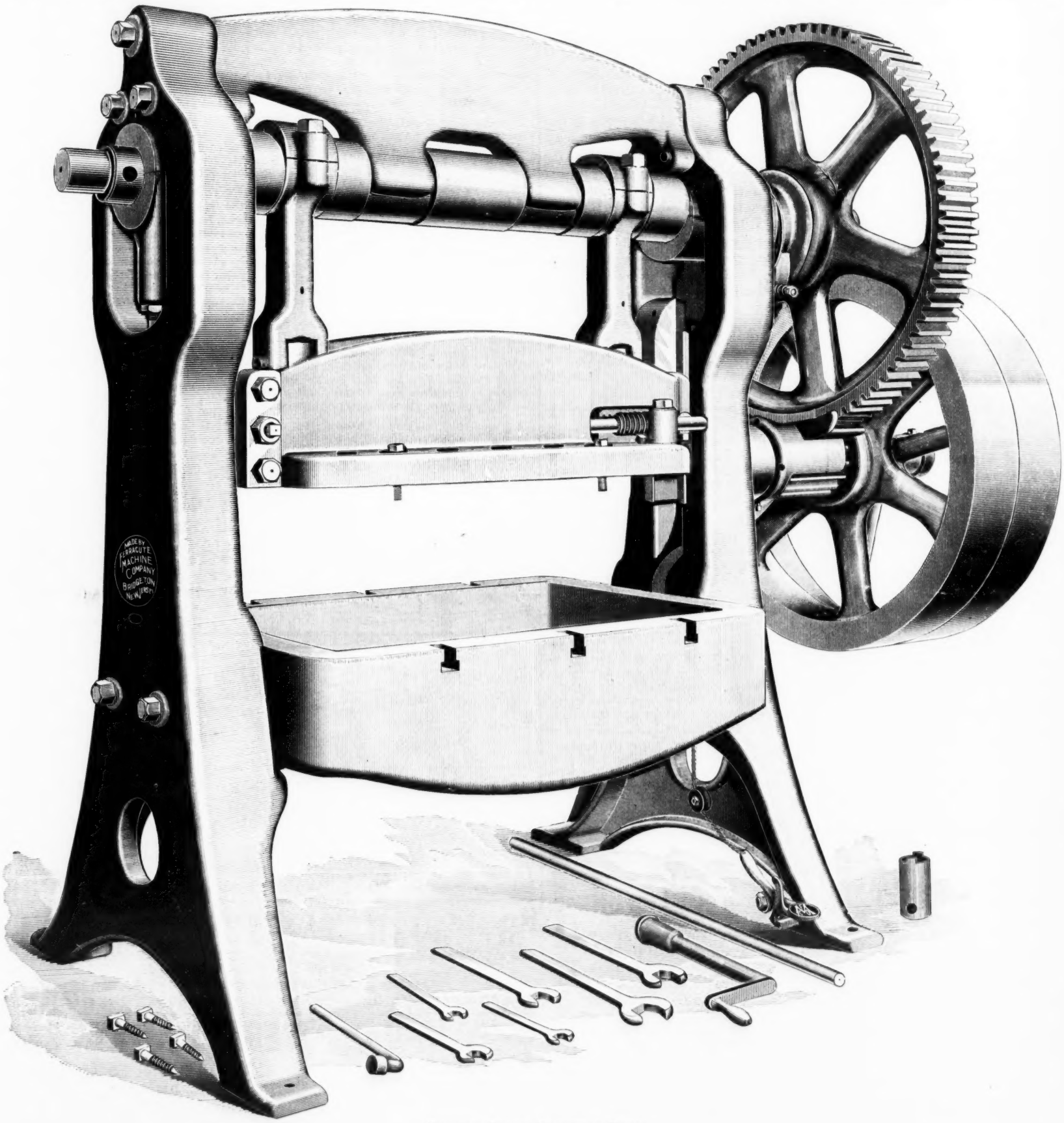
We illustrate (page 11) a large double crank geared stamping press of new design, the particular machine illustrated being the fourth in a series of nine similar machines, ranging in weight from about 10,000 pounds to 20,500 pounds. It will be noticed that the frame of the machine is of such form as to secure the greatest possible rigidity and strength, the sides rising in straight lines from the bolster to the bearings for the crank-shaft. This shaft is supported at two points between the pitman connections, there being two pitmans in order that perfect parallelism between ram and bed may be maintained.

The vertical adjustment of the ram is by means of two screws, which are not rotated in making the adjustment, but are provided with worm-gear nuts, that are turned by means of worms that are on a horizontal diagonal shaft, the right-hand end of which, with one of the worms, is seen at the right of the ram. The other worm engages with the opposite side of the other nut. These nuts are split part way through, and when properly adjusted can be clamped firmly to the screws. The shaft is a solid steel forging, and the clutch is of the same construction as that shown in detail in our issue of

October 5th, and which, it will be remembered, possesses many novel and valuable features, which make it specially well fitted for its purpose in points of durability, certainty of action, economy of time and freedom from noise or liability of accident.

The bolster can be made of almost any required size, and is provided with die clamps adjustable in T-slots in the top face.

The illustration is $\frac{1}{12}$ size of the machine, which weighs 12,705 pounds; has a hole through bed 42″x28″; clear space between columns of 52″; standard stroke of ram 2″ (or longer to order;) adjustment of ram 3″; thickness of bolster 4″; fly-wheel 44″x7″, weighing 1,175 pounds and designed to run at 180 revolutions. The pressure safely exerted by the ram is 84 tons. The machine is built by the Ferracute Machine Co., of Bridgeton, N. J., from designs of its President, Oberlin Smith.



DOUBLE CRANK STAMPING PRESS.

The Grass Valley (Cal.) *Telegraph* says: "A mining location notice was recently recorded which reads: 'I hereby claim 1,500 feet of this ground up Big Squaw Ravine in a wobbly direction.'" None but a very crooked character would jump such a claim.

Gas Engines.

BY W. H. BOOTH.

With the progress of electric lighting the employment of gas engines for driving dynamos naturally attracts attention. As a variation in speed is fatal to steadiness of light considerable fault has been found with the gas engine, owing to the long period of time which elapses between the impulses or explosions. All gas engines are single-acting only and most do not explode oftener than once every two revolutions which is only a fourth of the number of "explosions" of a double-acting steam engine. Further the impulses of the gas engine are of great intensity, and this adds to the tendency which exists to produce irregular running.

Apart from the designedly fewer impulses of the gas engine at full power there remains the fact that at less than full power these are still further reduced in number. At least such is the case in probably the larger number of existing engines, though some are made which, at reduced power, still maintain the maximum number of explosions but of a smaller volume of gas. Taken all round, however, the Otto cycle seems to be found very satisfactory, if we are to judge by the large proportion of designs in which it is employed now that the patent has run out.

It is evident that an important detail in a gas engine is the governor which moves the hit and miss device actuating the gas valve. When an engine is fully loaded the governor stands always at a position which gives an explosion every other revolution, and the engine simply runs as quickly as it can against the resistance. Any additional work will cause a retardation of the engine. When an engine is not fully loaded, however, the admission of gas is stopped as soon as the revolutions exceed a given quantity, and does not again take place until the speed has fallen. There is a certain degree of delicacy in the governor beyond which it were useless to attempt to pass, but up to such a degree a governor is not so perfect as it might be. I ought rather to say it falls short of practical perfection. I will try and explain what appears to me perfection in a gas engine governor.

We will suppose an engine to be revolving at a speed of 200 revolutions per minute, an explosive charge is fired and the speed rises to 201 revolutions per minute. The energy in this explosive charge is sufficient therefore to add one-half of one per cent. to the engine speed. If when the speed again falls towards 200 the governor acts so delicately that it admits a fresh gas charge at the speed of 200½ revolutions, then will the speed rise to 201½. On the other hand, if the governor does not act until the speed falls to 199 it will require two explosions before it again shuts off the gas at a speed of 201.

A little thought shows us that the sensitiveness of the governor ought to coincide with the acceleration produced by one explosion. If less delicate it will allow the engine to vary through a wider range than necessary. If more delicate it cannot control the engine more closely than the force of one explosive charge will admit. Given however a governor whose delicacy is thus in excess of the energy acceleration we can, if we wish it, bring up the engine to the same standard, for we can increase the weight of the fly-wheel and thereby reduce the acceleration which is effected by an explosive charge, two fly-wheels practically halving the acceleration found when one only is employed. Until recently a speed of 160 revolutions per minute was about a

maximum with gas engines, but higher speeds of 200 and even more are now common.

An engine running at 200 revolutions and working upon the Otto cycle and fitted with two fly-wheels of the usual proportion will, even when not working at the full number of explosions, give, with a good sensitive governor and hit and miss device, so regular a speed to a line shaft that no difference in note of a smithy fan at about 3,600 revolutions, driven off such shaft, can be detected by the ear. This would seem to show that such an engine could certainly yield a steady electric light. The foregoing remarks are prompted by observation of some engines which will run perhaps with three explosive charges as closely consecutive as possible followed by an equal number of idle revolutions during which explosions, though possible, are omitted. This indicates a governor of insufficient delicacy, for a better governor would, under similar circumstances, have simply given an alternation of idle and of working strokes.

In every engine properly governed the number of strokes when explosions occur and the number when they might occur and do not should never differ by more than one. Thus if two consecutive explosions occur there should only be one non-explosive cycle before there occur another two explosive cycle.

Calling the cycles *E* or *N*, according as they are explosive or non-explosive, the following would be permissible: *E, E, N; E, E, N*, or *E, E, E, N; E, E, E, N;* so also would *E, N, N; E, N, N;* and its converse. But it would show bad governing if there occurred *E, E, N, N; E, E, N, N;* as the same power would be got from *E, N, E, N*, etc. We could permit *E, N; E, E, N; E, N, E, E, N*, because where the double *E* occurs there could be no better arrangement, and we merely know that the load is getting heavy and all the *E's* will become double with a little greater load. We could not, however, admit *E, N; E, E, E, N; E, E, N*, under a steady load, for all the *E's* should here have been simply double, though, of course, under a variable load this might properly occur.

The essential thing to observe clearly is that in the best possible governing at less than maximum power that cycle which is of lesser frequency will only occur singly, not in pairs. A string of *N's* will be followed by one *E* only or a string of *E's* by only one *N* unless the work has varied, and then will follow another string of the more frequently occurring cycle, but we should not expect to find a difference of more than one between different strings. Thus 10 *E, N;* 11 *E, N;* 10 *E, N* would be correct, but 10 *E, N;* 11 *E, N;* 12 *E, N* would be wrong for each string of *E's* should have been 11 in number.

It is, of course, difficult to attain such absolute correctness in practice as often a hit or a miss will depend on so infinitesimal a difference in the position of the knife edge contacts, and a miss may occur sometimes when a hit would perhaps have been better. The above, however, shows I believe what should be aimed at, namely, unity of the less frequently occurring actions of the hit or miss gear, and only a difference of one in the series of the frequent actions. Obviously such can only be properly determined by a brake trial or when machinery is simply running but not doing work, at least not variable work such as slotting or planing, etc.

I am inclined to think many complaints made against gas engines are due to the governing being deficient rather than to the speed variation caused by the relatively small ratio of impulses.

If an engine governed down to the point of unity in the occurrence of the *E* or *N*, whichever is the lesser, be still too variable in its speed, the only remedy is an increase in the fly-wheel weight or diameter so that the acceleration or retardation due to a single *E* or *N* may be brought within narrow range, the governing, if necessary, being brought into an equally narrow range of action. As a general thing it is the case that the governor is more open to improvement than the fly-wheel.

MANUFACTURES

The Philipsburg, N. J., Iron Works has begun running on full time.

The York Mills at Saco, Me., have started up on two-thirds time.

The Duquesne Forge at Rankin, Pa., has started up full handed.

The Bartlett & Lyman Cotton-mills at Woonsocket, R. I., have resumed work.

The large planing-mill and lumber yard of the James Herdman Lumber Co., at Zanesville, O., were recently destroyed by fire.

The electric light directors at their meeting in Northampton, Mass., voted to erect their new plant at once, the contract for the masonry and carpenter work being now ordered.

What is said to be the largest gas holder in America is now being built at Philadelphia for the East River Gas Light Company, Long Island. The holder is 184 feet in diameter, and 126 feet high, and its capacity is 4,000,000 cubic feet.

After a suspension of more than three months furnaces Nos. 2 and 3 of the open-hearth mill, and the Krupp washer department of the Cambria Iron Works, Johnstown, Pa., have resumed operations, giving employmeut to between 200 and 300 men.

The Carnegie Steel Works, Homestead, Pa., are turning out material for three post-office buildings to be constructed in the near future. The structures, which will be massive affairs, will be occupied by Washington, St. Paul and Worcester, Mass.

The Lehigh Valley shops in South Easton, Pa., which have been running for months with about one-fourth of the men suspended and an hour lopped off each day, started up recently on full time. Nearly all the old men are back in their places. There is a great deal of work to be done.

The buildings of the Piqua (Ohio) School Furniture Company, which was incorporated a short time ago with a capital stock of $100,000, are about constructed. Modern and improved machinery is ready to be placed in position, and in a few weeks employment will be given to a large force of men

The Standard Wheel Works Company report business brightening up with it. The works at Indianapolis has increased the force, and a branch at Kalamazoo was started up. The way orders are now coming in encourages the belief with the management that they are to have a good winter business.

A certificate of the incorporation of the Syracuse Steel Wire Company, for the purpose of manufacturing steel wire in Syracuse, has been filed in the office of the Secretary of State. The company has a capital of $20,000, and its directors are: Edwin D. Dickinson, Austin R. Dickinson, Charles P. Halcomb and William S. Teall, of Syracuse, N. Y.

Wilcox, Crittenden & Co., Waterbury, Conn., are putting a new roof on their foundry building. They have purchased the foundry plant, consisting of cranes, flasks and other appurtenances lately used by the Stiles & Parker Press Co., and are adding to their own large plant. This addition puts them in shape to do a largely increased business.

Announcement was made at Scranton, Pa., October 25th, that the South Steel-mills of the Lackawanna Iron and Steel Company would resume work after being practically idle since August 1st. Eight hundred men and boys will be given employment. One large order for steel rails is already received and enough more are expected to keep the mill running all winter.

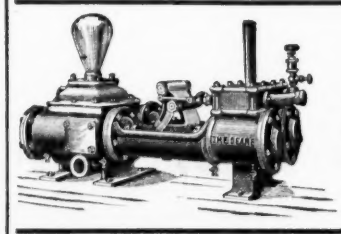
Superintendent Hannon, of the Department of Public Works of New York, has awarded the following contracts: For constructing an iron bridge over the Erie canal at Genesee street in Utica to the Hilton Bridge Construction Co., of Albany, at $37,450. For re building bridge No. 15 (Fitzgerald's bridge) over Champlain canal, to Cunningham & Montey, of Sandy Hill, at $2,753.

Markt & Co., Limited, 79-85 North Moore street, New York, have received a stock of Eicken & Co.'s Westphalian steel which they store with Charles E. Ring, Brooklyn, near Roosevelt ferry. Their special No. 8 turning steel is especially recommended for turning hard rolls and steel. Markt & Co. are also importers of Soeding & Halbach's new machine finished anvils. The faces of these anvils are planed and the holes drilled and mortised.

A Massillon, O., dispatch, November 6th, says: As the result of a conference between the employes and proprietor of Corn's Iron Works today, work will be resumed at that plant on Wednesday, after an idleness of four months. The scale agreed upon is the same as the new one which prevails in the Mahoning Valley. The pot furnace of Reed & Co.'s bottle works was started to day, the entire factory now being in operation.

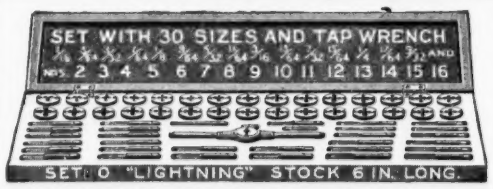
The Brown-Ketcham Iron Works, Indianapolis, Ind., are busy on a contract to furnish the iron work for a building in Kansas City, and have commenced shipping the material, of which there will be at least fifty carloads. They are also at work on material for one of the government buildings going up in Washington, D. C., and are shipping five carloads a week to that point. There will be thirty-five carloads of the shipments for this building.

The following announcement is made: The Inland Steel Co., successor of the Chicago Steel Works, hereby announces its purchase of the entire plant of that company, and of the land and buildings at Chicago Heights, Illinois, originally intended for the Chicago Steel Co. The placing of the machinery is being pushed as rapidly as possible with a large force of men, in the expectation that the works will be in operation early in December. All shapes made by the old company will be continued and new ones added as required. The



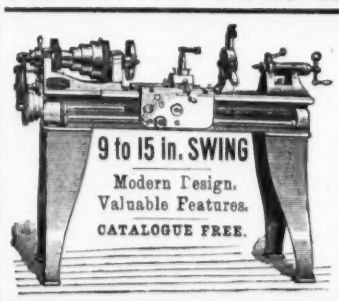
THE DEANE
OF HOLYOKE
STEAM PUMPS
DEANE STEAM PUMP CO.,
HOLYOKE, MASS.

CRESCENT STEEL CO.
PITTSBURG, CHICAGO, NEW YORK.
STEEL FOR Lathe and Planer TOOLS, Cold Chisels, Punches & Dies, Milling Cutters, Molding Bits, &c.
SHEET STEEL, POLISHED Drill Rods, SPRING STEEL, Machinery Steel, COILED SPRINGS, Steel Forgings, ETC.



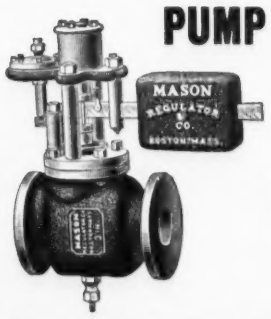
"Lightning" Screw Plates
For Machinists, Electricians, Bicycle Repairers, &c. Adjustable Dies with Guides.
SEND FOR CATALOGUE.
WILEY & RUSSELL, MFG. CO.,
GREENFIELD, MASS.

"R. MUSHET'S SPECIAL STEEL"
SAVES LABOR in being able to run at GREATLY INCREASED SPEEDS. FEWER GRINDINGS. No WASTE in redressing.
SOLE REPRESENTATIVES IN THE UNITED STATES.
B. M. JONES & CO.,
BOSTON: 11 & 13 Oliver St., NEW YORK: 143 Liberty St.



SEBASTIAN LATHE CO.
117 & 119 Culvert St., Cincinnati, O.
Manufacturers of Foot and Power
ENGINE AND SPEED LATHES,
For General Machine and Jobbing Shop, Electrical and Experimental Work.
DEALERS IN MACHINISTS' TOOLS AND SUPPLIES.

A NEW STYLE
PUMP PRESSURE REGULATOR.



This is a Pressure Regulator, especially designed to meet the requirement of Steam Pumps in Elevator service.
The lever bearings are hung on hardened steel knife edges, which makes the Regulator in its working as sensitive as a pair of scales.
MASON REGULATOR CO.,
BOSTON, MASS., U. S. A.

BUFFALO FORGES
BLOWERS, EXHAUSTERS, HEATING FURNACES.
HAND BLOWERS, BLACKSMITH DRILLS.
BUFFALO FORGE CO
BUFFALO, N.Y.

ASBESTOS
SMOKE STACK PAINT
Used on the ships of the U.S. Navy and by the prominent Steamboat and Transportation Companies.
The only paint supplied in colors which has given absolute satisfaction where forced draught is used.
READY FOR USE
ALL ORDINARY SHADES.
H. W. JOHNS M'F'G CO.
87 MAIDEN LANE, NEW YORK.
NEW YORK JERSEY CITY CHICAGO PHILADELPHIA BOSTON LONDON

THE WORLD'S COLUMBIAN EXPOSITION OF 1893.
This Special Columbian Exposition Number of *London Engineering*, 140 pages of text, 250 plates and engravings and 12 folding plates, contains a full description of the history, organization and scope of the Exposition; illustrations of all the buildings in Jackson Park, etc., etc. It also contains an exhaustive illustrated description of the new Cunard steamer "Campania," which started on her first run on April 22d.
BOUND IN CLOTH, $2.50 NET.
JOHN WILEY & SONS, New York.

greater capacity of the works will insure the quick filling of all orders and the excellence of the product will be strictly maintained. The services of the efficient employes of the Chicago Steel Works have been secured.

The Turner & Seymour Mfg. Co., at Torrington, Conn., have decided to build their new foundry of iron, and have placed the contract with the Berlin Iron Bridge Co., of East Berlin, Conn. The old foundry was burned a short time ago, and the company have decided to build the new foundry entirely of iron. The roof will be furnished by the Berlin Iron Bridge Co., of East Berlin, Conn., and will consist of iron trusses and iron purlins covered with the Berlin Iron Bridge Company's patent anti-condensation corrugated iron. When completed the building will contain no wood work whatever except the window frames and casings, so that it will be absolutely fire-proof, and it is the intention of the Turner & Seymour Mfg. Co. to carry no insurance on the building as the Berlin Co. guarantee that if all the wooden flasks which the company use at any one time were piled in one place in the building and fired that the roof would suffer no damage.

The Mossberg Mfg. Co., of Attleboro, Mass., make the following announcement: We desire to call attention to recent changes in our location and facilities. Having united our Attleboro and North Attleboro plants, and also added to them by the purchase of additional machinery, we now occupy a new building with more than double our former floor area. With a better arrangement of departments and improved methods, we are now in a position to produce any work in our line more perfectly and economically than ever before. It is our intention for the future to always carry on hand a complete line of jewelers' tools, while still paying particular attention to designing and constructing special complicated and automatic machinery of any kind. Thanking our friends for esteemed favors which have made these extensions necessary, we trust by keeping the lead in improvements, to merit a still larger share of trade in this class of goods.

Machinists' Supplies and Iron.

NEW YORK, November 11, 1893.

Iron—American Pig We quote Standard Northern brands No 1 Foundry, $14.00 to $15.00; No. 2, $13.50 to $14.25; Gray Forge, $12.25 to $12 50. Southern brands of good quality are obtainable at $13.00 to $14.00 for No. 1 Foundry; $12.00 to $13.00 for No. 2, and $11.25 to $12.00 for Gray Forge.

Antimony—The market is quiet and easy. We quote L. X., 9¾c. to 9⅞c.; Cookson's, 10c. to 10¼c.; Hallett's, 9¼c. to 9.35c., and U. S. French Star, 10c.

Lard Oil—Prime City is quoted at 79c. to 80c.

Copper—The market is firm. For Lake Copper the spot asking price is 10c., while 9¾c. is bid. The consumptive demand for Lake and Casting Copper is improving. Casting Copper is held at 9⅝c. to 9.40c.

Lead—The market is weak with offerings at 3.35c. to 3.40c. for prompt delivery.

Spelter—The demand is light, but the tone of the market indicates improvement. Holders now ask 3.70c. to 3.75c. Five car loads for December sold at 3.67½c.

Tin—The market is firmer and dull; sellers are asking 20.60c. for spot and November and 20.65c. for December. Buyers are indifferent and expect lower prices to prevail.

WANTED

"Situation and Help" Advertisements only inserted under this head. Rate 30 cents a line for each insertion. About seven words make a line. Copy should be sent to reach us not later than Saturday morning for the ensuing week's issue. Answers addressed to our care will be forwarded.

First-class die tool maker wants position. Box 129, AMERICAN MACHINIST.

Wanted—Agents to sell tools for E. G. Smith, Columbia, Pa. See advertisement, page 18.

Mechanical draftsman, Swede, wants position. Box 127, AMERICAN MACHINIST.

Go into cranes, engines, ice machines Hire me to assist. Box 125, AMERICAN MACHINIST.

Machine draftsman of drawing-room experience wants engagement. Box 126, AMERICAN MACHINIST.

Draftsman will begin work Jan. 1st, good rec.; skill & ability; mach tools N. O. Jay, AM. MACH.

Draftsman and good vise hand wishes position; has experience in designing stationary and haulage engines; can handle men. B. C., AM. MACH.

Wanted—Foreman for repairing, concentrating and mining machinery; state wages, age, experience Address Steady, care of AMER. MACHINIST.

A1 all around machinist and designer wants position with a party to back his new pat. rotary motor for small and large steam or water power; also water meter. Box 128, AMERICAN MACHINIST.

Wanted—Position as superintendent by a man with long experience in equipping plants, reducing cost and systematic methods and handling men; best of refs. Address A. C. B., care AMER. MACH.

Patternmaker, 25 years' experience, 14 years foreman, desires situation; experience, engineering, electrical and textile for green sand and loam castings; best of refs. Address Box 130, AM. MACH.

A member of the A. S. M. E., 38, married, desires position as general superintendent or manager of machine works, where executive ability, practical knowledge of the business in all its details, integrity and devotion to the interests of the concern, would be appreciated and suitably rewarded. W. O. W., AMERICAN MACHINIST.

✣ MISCELLANEOUS WANTS ✣

Advertisements will be inserted under this head at 35 cents per line, each insertion. Copy should be sent to reach us not later than Saturday morning for the ensuing week's issue. Answers addressed to our care will be forwarded.

Cheap 2d hd lathes & planers. S. M. York, Clev'd, O.

Auto. Steam Flue Cleaners. Kelley Co., Erie, Pa

For Sale—Second-hand drill presses, engine lathes & planers. Dietz. Schumacher & Co., Cincinnati, O.

Light and fine machinery to order; Foot Lathe Catalogue for stamp. E. O. Chase, Newark, N. J.

Draftsmen's new comb. triangles, etc.; cir. free; small sample, 10c. D. J. Kelsey, New Haven, Conn.

Wanted—Light machinery or specialties to build. P. G. Fleming's Machine Works, Elizabeth, N. J.

For Sale—One 27 'x14 foot bed screw-cutting engine lathe. A splendid tool in first-class condition. C. M. & J. B. Hart, Clarksburg, W. Va.

Agents—$5 speed gage, new, valuable, sells; shows constantly speed and slightest variations. Geo. N. McLauthlin & Co., 120 Fulton St., Boston.

For sale one 2 'x24' Jones & Lamson flat turret lathe, triple-geared head, new, will sell low. Address Box 116, AMERICAN MACHINIST.

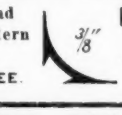
For Sale—Hand power traveling crane, 16-foot span, with racking gear and brake; low price; terms cash. The Sargent Company, Chicago, Ill.

For Sale—A small machine shop well equipped with first class machines and tools. For particulars address H. F. Quickel, P. O. Box 27, Harrisburg, Pa.

Business Wanted—A successful sup't of large experience with leading engine and mach. tool builders, would like to engage as partner in some mfg. or engineering business; has moderate capital, lib. educ'n & ex'l. refs. W. W. Rider, AM. MACH.

Introduction and negotiation of American patents and machinery to English manufacturers and agents. Write for circular to Geo. Richards, M. I. M. E., Mechanical and Consulting Engineer, No. 5 Laurence Pountney Hill, London, England.

Improved Lead Fillet for Pattern Makers. SAMPLES FREE.



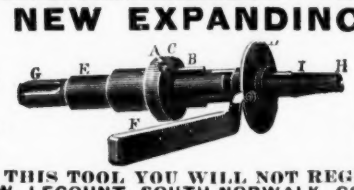
H. WHITE, Sole Manufacturer, 44 North 4th St., PHILADELPHIA, PA.

DON'T ACCEPT ANY SUBSTITUTE FILE.
INSIST ON HAVING
NICHOLSON.

NICHOLSON FILE CO.
PROVIDENCE, R. I., U. S. A.
3000
VARIETIES FILES
[X. F.] & INCREMENT CUT FILES.

LECOUNT'S NEW EXPANDING MANDREL.

Amateur's Size.
Taking anything from ⅛ to 1 inch inclusive.
Price.....$5.00
Patented Dec. 25, 1877.



Machinist's Size.

No.		Price.
1	⅛ to 1 in.	$10
2	1 " 1½ "	14
3	1½ " 2 "	18
4 (with screws)	2 " 3 "	32
5 "	" 3 " 4 "	44

IF YOU WILL TRY THIS TOOL YOU WILL NOT REGRET THE EXPENSE.
C. W. LECOUNT, SOUTH NORWALK, CONN.
SPECIAL MANDRELS FOR SPECIAL JOBS MADE TO ORDER.
These goods are for sale by CHAS. CHURCHILL & CO., L'td. 21 Cross St., London, England.

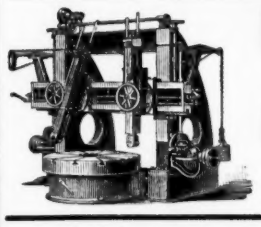
THE BERLIN IRON BRIDGE CO.
Office and Works,
No. 8 Railroad Ave., East Berlin, Conn.
CHAS. M. JARVIS, Pres. and Chief Engineer. BURR K. FIELD, Vice-President.
FRANK L. WILCOX, Treasurer. GEO. H. SAGE, Secretary.

Engineers, Architects and Builders of Iron and Steel Bridges and Buildings.

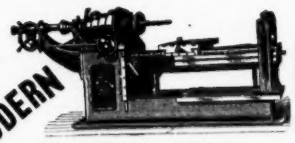
The above illustration is taken direct from a photograph and shows the interior of a Machine Shop designed and built by us for The Ball & Wood Co., at Elizabethport, N. J. The building is 80 feet in width by 180 feet in length. The central portion is 40 feet from center to center of traveling crane rails, while the two story wings on each side are 20 feet in width. We built this entire building, including the brickwork and foundations, the whole complete ready for the machinery.

SEND FOR OUR ILLUSTRATED CATALOGUE.

BORING AND TURNING MILLS
COMBINING EVERY IMPROVEMENT.
14 SIZES FROM 5 TO 20 FEET.
BETTS MACHINE COMPANY,
WILMINGTON, DEL.
Chicago Office: 14 South Canal St.



FITCHBURG MACHINE WORKS,
MANUFACTURERS OF
FITCHBURG MODERN
AND OTHER
METAL-WORKING MACHINES,
THE CELEBRATED
ENGINE LATHE



Horizontal Boring and Drilling Machine.

SEND FOR CATALOGUE E.
FITCHBURG, MASS.

The German-American Emery Wheel Co.,
Manufacturers of
SOLID EMERY WHEELS.
Discount 80 per cent. on Circular Price List. Send for it.
AGENTS WANTED.
Cor. High Point and Summit Avenue,
HOBOKEN, N. J.

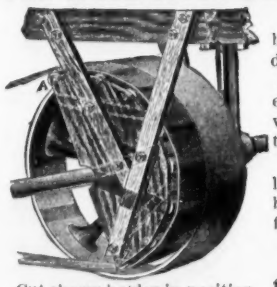
VOLNEY W. MASON & CO.,
Friction Pulleys, Clutches and Elevators,
PROVIDENCE, R. I.

GRANT GEARS
Ready Made Cut Gears.
Ready Made Cast Gears.
Ready Made Brass Gears.
Gears Made to Order.
Gear Cutting.
Gear Book, 15 cents.
Treatise on Gears, $1.00.
Gear Cutting Machines.
GEORGE B. GRANT,
Lexington, Mass.,
and 125 South 11th St.,
Philadelphia, Pa.

"Star" Foot Lathe Swings 9x25 in.
LATHE
Screw Cutting Automatic Cross Feed, etc.
Scroll Saws, Circular Saws, Lathes Mortisers.
LATHE
Catalogue Free of all our Machinery.
Seneca Falls Mfg. Co. 687 Water St., Seneca Falls, N.Y.

JESSOP'S STEEL
FOR TOOLS, DRILLS, DIES, &c.
ALL KINDS IN STOCK.
Manufactory, SHEFFIELD, ENG.
Chief Am. Office, 91 JOHN ST., N. Y.
WM. JESSOP & SONS, LTD.
Established a century ago.
Medal World's Columbian Exposition 1893.

THE WELLINGTON BELT HOLDER.



Cut shows holder in position beside driving pulley.

Large or small belts shifted from driving pulley and eld at rest, and easily slipped back when machine is to be started.

It dispenses with loose pulleys, saves belts, and is perfectly safe.

It is *cheap*.

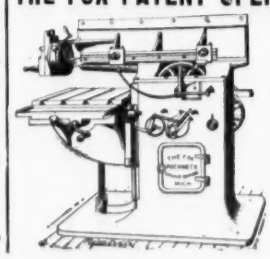
Write for descriptive circular and price list to

COOKE & CO.,
163 & 165 WASHINGTON STREET, NEW YORK,
And mention American Machinist.

HENRY CAREY BAIRD & CO.,
INDUSTRIAL PUBLISHERS, BOOKSELLERS AND IMPORTERS,
810 Walnut St., Philadelphia.

☞ Our New and Revised Catalogue of Practical and Scientific Books, 88 pages, 8vo., and our other Catalogues and Circulars, the whole covering every branch of Science applied to the Arts, sent free and free of postage to any one in any part of the world who will furnish his address.

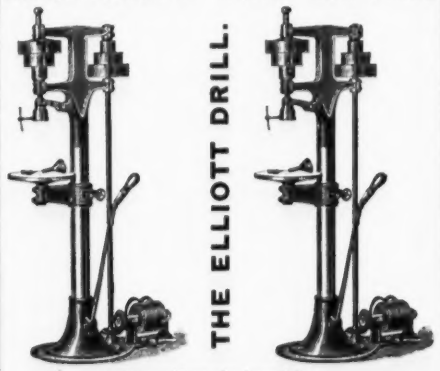
THE FOX PATENT OPEN SIDE SHAPER.



No springing of ram. No overhanging table. Quick Return, Stroke Under Perfect Control. Can be Instantly Adjusted 1 16 in. or 24 In. No Screws to Monkey with. Powerful Quick, Accurate. Write for circular.

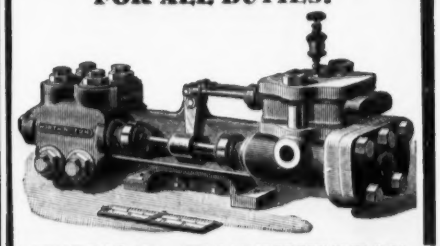
The Fox Machine Co.,
325 N. Front St.,
Grand Rapids, Mich.
135 Finsbury Pavement, London, England.

The Elliott Drill Press
FOR ANY LIGHT WORK
LARGE RANGE OF WORK - LOW PRICE

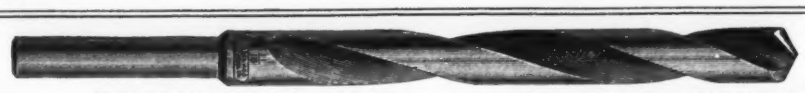


Now Manufactured by
A. J. WILKINSON & CO.,
180 to 188 WASHINGTON ST., BOSTON, MASS.
SEND FOR CATALOGUE.

WORTHINGTON STEAM PUMPS
FOR ALL DUTIES.



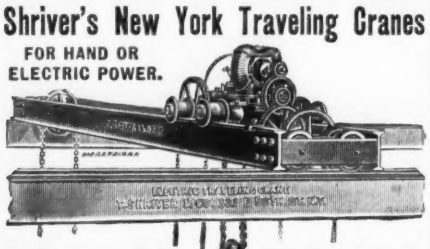
HENRY R. WORTHINGTON,
NEW YORK,
BOSTON, PHILADELPHIA, CHICAGO,
ST. LOUIS, DENVER.



Established in 1874. Corner Lake & Kirtland Sts., Cleveland, O.
100 & 102 Reade Street, New York.
CLEVELAND TWIST DRILL CO. 85 Queen Victoria St., London, Eng.

Shriver's New York Traveling Cranes

FOR HAND OR ELECTRIC POWER.



T. Shriver & Co. 333 East 56th St. NEW YORK.

MANUFACTURERS OF

TRAVELING CRANES of 1½, 2, 3, 5 and 10 Tons capacity, to be operated by Hand, or **wholly** or **in part** by Electricity.

WANTED.

1 Power Elevator, second hand, to li t about 2,500 pounds.
1 Radial Drill about 40 swing.
1 Planer about 40″ x 10′ bed.
1 Planer about 30 x 6′ bed, also 3 lathes one 19″, one 30″ and one 36″.
Good second-hand tools will do.
Address with price and particulars to
"B" BOX 88, NEWARK, N. J.

ENTIRE OUTFIT
Machine and Boiler Shop
Modern Style Tools--A1 Order.

Special Low Prices Before Removal.

Engine Lathes, 13, 15, 16, 18, 20 and 24 in.
Planers, 20 x 4 ft., 24 x 8 ft., 30 x 10 ft., 35 x 7 ft.
Upright Drills, "Sensitive," 20, 24 and 40 in.
Radial Drill with 5 ft. arm.
Shapers 8, 12 and 15 in. Stroke.
Screw Machine, "Garvin," No. 1 Auto. Chuck.
" " "Brown & Sharpe," No. 1 Wire feed.
" " "Niles," 1⅞ in. hole, Bk. Gears, Carriage feed, Turret feed and with Chucks and Tools.
Bolt Cutter and Pipe Cutter.
Milling Machine, "Lincoln" with Vise.
Universal Milling Machine with all attachments.
Vertical Turret Mkg. Mch., 36 in Brown & Sharpe.
Upright Boring and Turning Mill, 38 in.
Punch Presses, Power and Foot.

BOILER SHOP TOOLS.

Single Punch and Shears, 1 in. hole, 1 in. steel center of 53 in. "Improved Style," weight 1',000 lbs. Used 3 months.
Boiler Bending Rolls, 8 ft. "Improved Style," with Hinged housing.

J. J. McCABE,
SUCCESSOR TO **E. P. BULLARD'S** N.Y. Mach'y Warerooms.
14 Dey St., NEW YORK.

GRAY IRON
CASTINGS

Machinery Castings from small to 10 tons each. Modern practice and facilities. Pickled or rattled. Capacity 20 tons daily. Send for Estimates. Guaranteed delivery. Write us.

THE SPRINGFIELD MACHINE TOOL CO.,
SPRINGFIELD, OHIO.

CHAPLIN TRY AND CENTRE SQUARE.

CATALOGUE FREE.

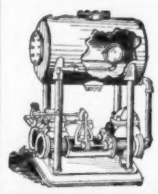
STANDARD TOOL CO., Athol, Mass., U. S. A.
Manufacturers of MACHINISTS' FINE TOOLS.

WE ARE OFFERING
BARGAINS

from the Equipment of the **United Electric Traction Co.'s Works,** of Marion, N. J., comprising
Engine Lathes, from 14″ to 48″ swing.
Hand Lathes, from 10″ to 20″ swing.
Planers, from 24″x5′ to 42″x12′.
Shapers, from 15″ to 20″ stroke.
Drill Presses, all sizes up to 24″ swing.
Milling Machines, Plain and Universal.
Brown & Sharpe Screw Machines.
1 Large Newton Slotting Machine.
1 Large Pond Mach. Tool Co.'s Radial Drill Press.
3 Gould & Eberhardt Automatic Gear Cutters, 36″, 48″, and 60″.
1 Betts Machine Co. large Horizontal Boring Mill.
2 Large Bliss Power Presses.
1-10 H. P. Baxter Engine, with 15 H. P. Boiler, complete, as good as new.
Also, Tool Grinders, Die Sinkers, Tapping Machines, Bolt Cutters, and large Pattern and Blacksmith Shop Equipments.
These tools are in good order and of the very best makes in this country. They will be sold at remarkably low prices
Call at our salesroom and inspect them, or write for complete descriptive circular and price list.

THE GARVIN MACHINE CO.,
LAIGHT & CANAL STS., NEW YORK

IF YOU WANT ANYTHING IN THE LINE OF
DROP PRESSES · DROP HAMMERS · STAMPS OR AUTOMATIC DROP LIFTERS.
SEND FOR CATALOGUE TO
Miner & Peck Mfg. Co.
NEW HAVEN, CONN.
LARGEST LINE IN THE MARKET



AUTOMATIC FEED PUMPS AND RECEIVERS

For returning hot condensed water to boiler.

STEAM PUMPS FOR ALL DUTIES.

THE BUFFALO STEAM PUMP CO.,
WORKS, BUFFALO, N. Y.
BRANCH OFFICES { 76 JOHN STREET, N. Y. CITY / 55-57 CLINTON STREET, CHICAGO, ILLS.

GRAHAM TWIST DRILL AND CHUCK CO., DETROIT, MICH., U. S. A.

SOLE MANUFACTURERS OF
GRAHAM'S GROOVED SHANK TWIST DRILLS AND CHUCKS.

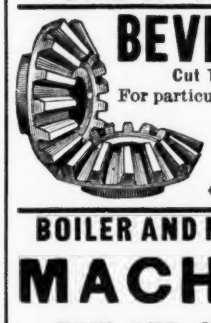
Endorsed by Practical Mechanics Everywhere. Send for Catalogue

---

American Standard Gauge & Tool Works,
WILMINGTON, DEL.

Adjustable **SHELL REAMERS**

⅝ inch to 5 inch.
JAMES A. TAYLOR & CO.
Send for New Pamphlet.



BEVEL GEARS,

Cut Theoretically Correct.
For particulars and estimates apply to
HUGO BILGRAM,
MACHINIST,
Successor to
BREHMER BROS.,
440 N. 12th St., Philadelphia, Pa.

BOILER AND MACHINE SHOP
MACHINERY

NEW AND SECOND HAND.

Boiler Rolls, 8 ft. 3 in. between Housings.
Punch, 21 in. Throat, with Shear Block.
Hand Power Boiler Rolls.
Boiler Clamp.
Engine Lathes, from 12 in. to 92 in. Swing.
Planers, " 20 " " 62 " Wide.
Drills, " 16 " " 44 " Swing.
Radial Drill, Hilles & Jones, 48 " Arm.
Turret Lathes, No. 12, Jones & Lamson. A1.
No. 0, Am. Tool & Mach Co A1.
Wheel Lathe, 88 in. Swing, with Two Tool Carriages
Quartering Machine, Bement, Double Right and Left Hand.
Stiles Presses, No 4, Fowler No. 0 and 1½.
Pratt & Whitney Screw Machines, No. 1, 2 and 3.
Garvin No. 4 Miller, No. 2 Hand Miller.
Pratt & Whitney No. 3 Hand Miller.
Drop Hammer Dynamo, large lot, Polishing Mchy., Belting, &c.

SEND FOR OUR LATEST LIST.

GEO. PLACE MACHINE CO.,
Warehouse: 511 and 513 WEST 13th STREET.
Office: 120 BROADWAY, NEW YORK.

CASTINGS

For Machinery of any size, from patterns or drawings. Quality and finish unsurpassed. Prices way down.

L. E. HOYT & CO.,
WALTON, DEL. CO., N. Y.
New York Agent, CLEVELAND FOOTE, 47 Broadway.

Paragon Drawing Instruments, Extra and Best Quality; German Drawing Instruments, Paragon, Duplex, Universal, Anvil Drawing, Helios, Blue Process Papers, Scales, Triangles, T-Squares &c., &c. Catalogue on application. At Columbian Exposition: Liberal Arts Building, Section E. M. 103.

SOFT CASTINGS,

Made from best grades of Pig Iron for Light Machinery, Electric Work, etc.

THE BURR & HOUSTON CO.,
33 TO 39 FRANKLIN ST., BROOKLYN, N. Y.

GEARS

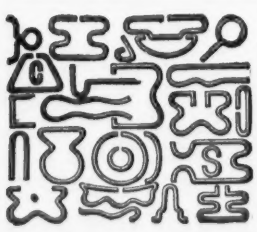
EVERY STYLE, SMALL OR LARGE.
1100 SIZES IN STOCK. SEND FOR CATALOGUE.
BOSTON GEAR WORKS,
35 Hartford Street, BOSTON, MASS.

EICKEN & CO.'S CRUCIBLE TOOL STEEL

HAGEN, WESTPHALIA, GERMANY.

SPECIAL No. 8, makes a fine finish on the hardest Rolls; Boss Cold Chisel Steel; High Grade Twist Drill, Tap, Punch, Reamer, Wood and Milling Cutter Steel and Blanks.
The **HIGHEST QUALITY**; Inducements to the Trade and large Users.

REPRESENTED BY EDW'D VORSTER. } **IMPORTERS & EXPORTERS.** { MARKT & CO., Agts. 79-85 N. Moore St., New York.



BLAKE & JOHNSON,
WATERBURY, CONN.
Builders of WIRE FORMING MACHINES

With F. B. Manville's Patent Sliding Former,

For making articles from the coil, of either round, half-round, flat, or square wire, similar in shape to those shown in the cut herewith. Also similar articles made to order.
Send samples of articles required, and mention quantity wanted, that we may quote prices for either machine or the goods, whichever may be desired.

☞ **Bicycle and Labor Saving Machinery a Specialty.**

SEND FOR CATALOGUE.
WORCESTER MACHINE SCREW CO

Manufacturers of Set, Cap & Machine Screws, Studs, etc.

MACHINERY
For Reducing and Pointing Wire.

ESPECIALLY ADAPTED TO POINTING WIRE RODS AND WIRE FOR DRAWING.
For Machines or Information address the Manufacturer,
S. W. GOODYEAR, Waterbury, Conn.

WE LEAD, OTHERS TRY TO FOLLOW.

If it is not true that we are building **THE BEST BLOWER** now on the market, why this haste on the part of others to discard methods of construction long considered by them as good enough, and why their efforts to imitate our new ideas?

When you require a positive blast and want something efficient and economical, write to

THE CONNERSVILLE BLOWER CO.,
CONNERSVILLE, IND.

A SPLENDID 16-INCH LEVER DRILL

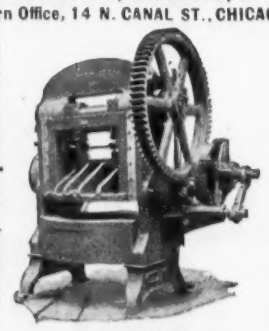
CAT. NO. 3. AT VERY LOW PRICE.

THE GEO. BURNHAM CO., Worcester, Mass.

W. C. YOUNG MFG. CO., WORCESTER MASS.
Foot Lathes, Engine Lathes,
SHEARS AND PUNCHES.

E. W. BLISS CO.,
1 ADAMS ST., BROOKLYN, N. Y.
Western Office, 14 N. CANAL ST., CHICAGO, ILL.

Punching and Drawing Presses, Drop Hammers.



Dies, Shears and Special Machinery.

OWNERS OF
THE STILES & PARKER PRESS CO.

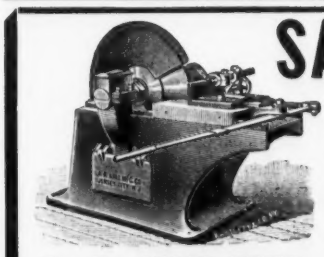
Stover Power Hack Saw and Friction Drill.

This Drill is for light, sensitive and rapid drilling. Has greatest power when speed is slow and is most sensitive when speed is high.

Power Hack Saw is made in two sizes, No. 1 cuts off metal up to 4½ in. No. 2 cuts off metal 6 in. x 8 in. Satisfaction guaranteed. Send for circulars and prices.

STOVER NOVELTY WORKS,
23 River Street, FREEPORT, ILL.

SMALL MACHINE SHOP
FOR SALE OR TO LET.
210 E. 43d St., NEW YORK.
WATSON & STILLMAN.



SAW
FOR Cutting Hot Iron or Steel.

A. R. KING MFG. CO.,
ERIE, 11th & 12th Sts.,
JERSEY CITY, N. J.
MACHINERY AND TOOLS.
Heavy Machine Castings.

At the World's Columbian Exposition the highest medals were awarded to the

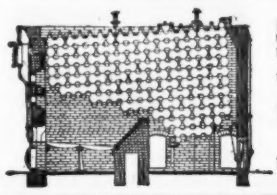
P. H. & F. M. ROOTS CO.,

FOR THEIR

PRESSURE BLOWERS, GAS EXHAUSTERS, FORCE PUMPS, PORTABLE FORGES, BLACKSMITHS' BLOWERS, and COMBINED FIRE BED and TUYERE IRON.

These are recognized as the leading machines in the market.

S. S. TOWNSEND, Gen. Agt., COOKE & CO., Selling Agts. } 163 & 165 Washington St. NEW YORK.
Catalogues, prices, etc., on application.



Absolute Safety from Destructive Explosion—Highest Attainable Economy of Fuel—Rapid Generation of Dry or Superheated Steam—Durability—Low Cost of Maintenance—Ease of Transportation and General Efficiency are among the advantages possessed by the "Wharton-Harrison" form of boiler.

Send for Descriptive Pamphlet—Drawings, Specifications, and Estimates promptly furnished for any amount of power from 4 H P. up.

State requirements and consider our proposition.

HARRISON SAFETY BOILER WORKS,

PHILADELPHIA, PENNA.

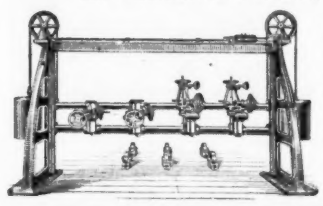
NEW YORK, N. Y. 41 Dey Street. | CHICAGO, ILL. 187 La Salle Street. | ATLANTA, GA. 9 No. Pryor Street.

THOS. H. DALLETT & CO.,

YORK ST. & SEDGLEY AVE., PHILADELPHIA.

MANUFACTURERS OF

Portable Drills, Hand Drills, Boiler Shell Drills, Light Drill Presses, also ELECTRIC MOTORS.



Specially adapted for driving Machine Tools, Cranes, Elevators, Pumps, Presses, and other Machinery.

HARD FIBRE A Substitute for Brass, Hard Rubber, Raw Hide and Leather,

For BEARINGS, GIBS, GEARS, PACKING, &c., &c.

MADE IN SHEETS, RODS, TUBES, WASHERS, &c.

Send for Catalogue and Samples.

DELAWARE HARD FIBRE CO., Wilmington, Del.

MONEY SAVED.

COMBINED DRILL AND COUNTERSINK FOR CENTERING LATHE WORK.

Size of body 3-10 in.; Drill ¼ in. and 3-32, or same size each end.
" " 15-64 in.; " 8-100 and 7-100.
" " 13-64 in.; " 1-16 inch. Price $1.50 per doz.

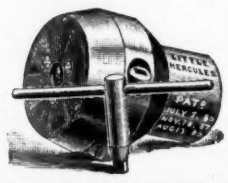
J. T. SLOCOMB & CO., Providence, R. I.

THE ONEIDA MFG. CHUCK CO.,

ONEIDA, N. Y., U. S. A.

MANUFACTURERS OF PATENTED

LATHE AND DRILL CHUCKS.



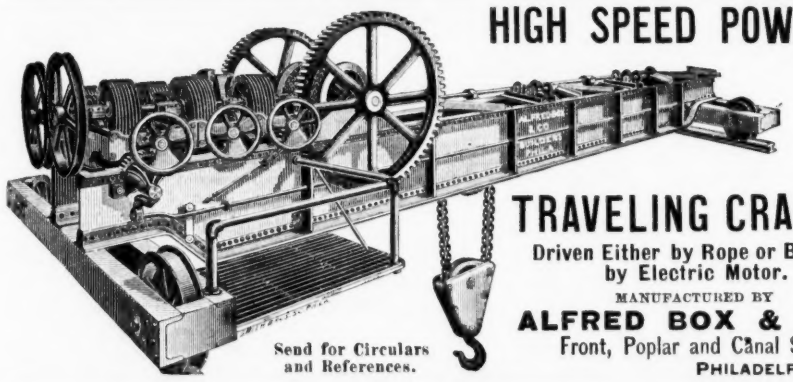
THE LITTLE HERCULES DRILL CHUCK, combines in its gripping mechanism three unequaled principles known in the field of mechanics, namely, the eccentric, lever and screw. In their combination and relative proportion in this tool we are enabled to offer a much superior tool, guaranteed to meet the claims we make for them. **Write for Catalogue.**

Norton Emery Wheel Co.

SEND FOR ILLUSTRATED CATALOGUE

Worcester, Mass.

HIGH SPEED POWER



TRAVELING CRANES.

Driven Either by Rope or Belt, or by Electric Motor.

MANUFACTURED BY

ALFRED BOX & CO.,

Front, Poplar and Canal Sts.,

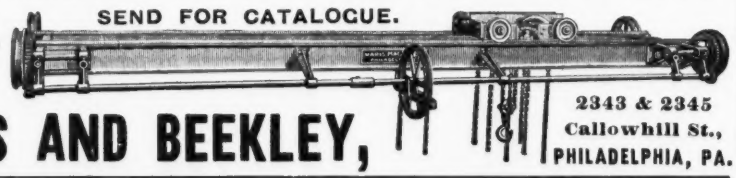
PHILADELPHIA, PA

Send for Circulars and References.

CRANES, TROLLEYS, PORTABLE HOISTS, OVERHEAD TRACK.

WORLD'S FAIR, Machinery Hall, Section 26, Column O. 30.

SEND FOR CATALOGUE.



MARIS AND BEEKLEY,

2343 & 2345 Callowhill St., PHILADELPHIA, PA.

TRUMP CHUCK.

The Cheapest and Best.

WILL HOLD ACCURATELY, STRAIGHT or TAPER Shank Drills.

Write for Prices to

TRUMP BROS. MACHINE CO., MFRS.

Wilmington, Delaware, U S. A.

For Sale by CHAS. CHURCHILL & CO., Ltd.

21 Cross Street, Finsbury, London, England.

Made in 3 sizes, viz.: No. 1. Holds 0 to ¼"
" 2. " 0 to ½"
" 3. " 0 to ⅝"

"PRACTICAL DRAWING."

By J. G. A. MEYER.

This valuable series of 93 articles having been concluded, copies of the **American Machinist** containing them will be sent by mail to any address in the U. S., Canada or Mexico, for $4.65, or single copies, 5 cts. each, postpaid.

Order now before our stock of papers is exhausted.

ADDRESS:

American Machinist,

203 BROADWAY, NEW YORK.

"MODERN LOCOMOTIVE CONSTRUCTION."

By J. G. A. MEYER,

This valuable series of 106 articles having been concluded, copies of the **American Machinist** containing them will be sent by mail to any address in the U. S., Canada or Mexico, for $5.30 or single copies, 5 cts. each, postpaid.

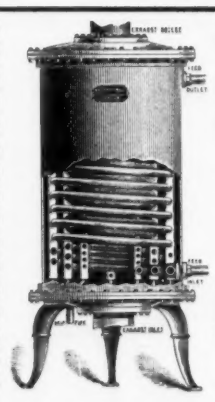
The Sample Tells the Story.

A sample of Dixon's pure flake lubricating Graphite, with interesting and instructive pamphlet,

Sent free of charge.

JOS. DIXON CRUCIBLE CO.,

JERSEY CITY, N. J.



The National Feed-Water Heater

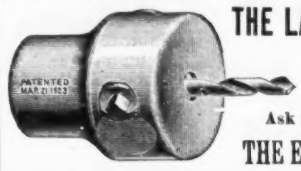
A brass coil Heater delivering water to the boiler at 210° Fahrenheit.

500,000 H. P. sold. Prices low. Satisfaction universal.

The National Pipe Bending Co.

82 River St. New Haven, Ct.

Ask your nearest Dealer, or send to the Manufacturers for

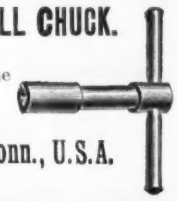


THE LATEST AND THE BEST TWO JAW DRILL CHUCK.

Strong, Accurate, Durable, Cheap.

Made entirely of Steel, Body Solid, of but one piece of Metal.

Ask for Style B.—Holds from the smallest to ½ inch.



THE E. HORTON & SON CO., Windsor Locks, Conn., U.S.A.

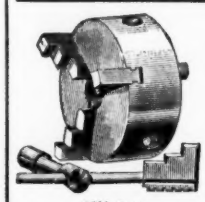
Or CHAS. CHURCHILL & CO., Ltd., 21 Cross St., Finsbury, London, England.

CUSHMAN CHUCKS.

We have recently improved our full line of Geared Scroll Chucks and have also added a 10½ inch and a 15 inch. Prices and discount on application.

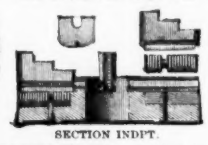
Send for our catalogue of all kinds of Lathe and Drill Chucks.

THE CUSHMAN CHUCK CO., HARTFORD, CONN.



1884 PAT

PEQ DRILL.



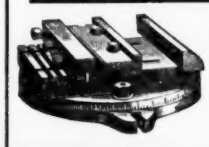
SECTION INDPT.

LATHE AND DRILL CHUCKS.

Buyers should note quality first and then price. We have made improvements which greatly increase the durability and accuracy of our tools. Please investigate our claims. We carry a large variety in stock, and design chucks and chucking tools for special purposes. Have you read our late catalogue?

THE D. E. WHITON MACHINE CO., 5 Oak St., New London, Conn., U.S.A.

OR SELIG, SONNENTHAL & CO., 85 QUEEN VICTORIA ST., LONDON, E. C., ENGLAND.



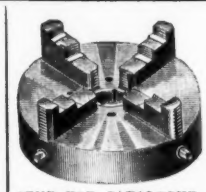
Jordan Planer Chucks.

SEND FOR CIRCULAR.

C. W. JORDAN,

4 Wayne St.,

WORCESTER, MASS.



SEND FOR CATALOGUE.

SKINNER CHUCKS.

Independent and Universal Chucks, Combination Lathe Chucks with patent reversible jaws, Drill Chucks, Planer Chucks and Face Plate Jaws.

SKINNER CHUCK CO.,

New Britain, Conn.

Cranes

CUPOLAS, LADLES, TRUCKS.

Detroit Foundry Equipment Co.,

702 TEMPLE COURT, CHICAGO. | DETROIT, MICH.

NEW YORK OFFICE, 182 FRONT ST.

Write **The Pratt Chuck Co.,** Clayville, N. Y., U. S. A., for free illustrated catalogue of

POSITIVE DRIVING DRILL CHUCKS,

made in eleven sizes and two styles, showing the only perfect system ever devised for holding and driving drills.

FOREIGN AGENCIES:

Ph. Roux et Cie, 54 Boulevard du Temple, Paris, France; E. Sonnenthal, Jr., Nueu Promenade No. 5, Berlin, Germany; Selig, Sonnenthal & Co., 85 Queen Victoria St., London, E. C., England.

Something New in Mechanics!

GEOMETRIC

Boring and Turning Tool.

An attachment to a drill press for boring and turning any geometrical figure, such as round, square, hexagon, octagon, triangle, diamond, star, oval, half-round, etc., in metals, wood or stone.

For particulars and prices address.

A. T. SHOEMAKER,

115 Broadway, New York City.

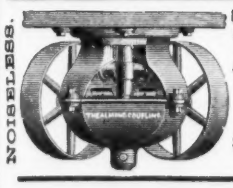
MACHINISTS' SCALES,

PATENT END GRADUATION.

We Invite Comparison for Accuracy with all others.

EVERY SCALE GUARANTEED. SEND FOR LIST.

COFFIN & LEIGHTON, SYRACUSE, N. Y.



The Almond Coupling

A NEW quarter turn motion to replace quarter turn belts and bevel gears.

T. R. ALMOND, MFR., 83 and 85 Washington Street, BROOKLYN, N. Y.

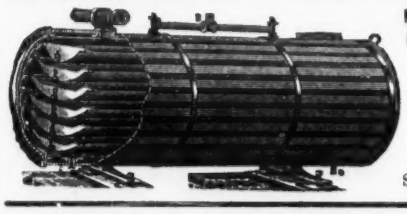
STARRETT'S TOOLS

ARE WARRANTED

SEND FOR CATALOGUE

L. S. STARRETT

ATHOL, MASS.



The HOPPES Live-Steam Feed-Water Purifier,

Guaranteed to Prevent Scale in Boilers.

Using any kind of water. Hard Sheet Steel Troughs.

Easily Cleaned.

HOPPES MANUFACTURING CO.,

Send for Catalogue D. **SPRINGFIELD, OHIO.**

AMERICAN WATCH TOOL CO.

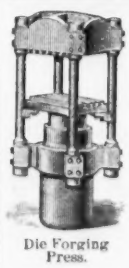
Waltham, Mass.

LATEST IMPROVEMENTS.

NEW STYLE.

NEW PRICES.

GROWING RAPIDLY in FAVOR



Die Forging Press.

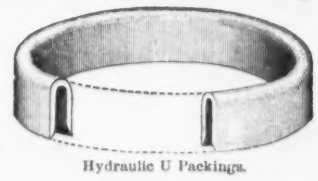
HYDRAULIC MACHINERY,

PRESSES, PUMPS, PUNCHES, JACKS, VALVES, FITTINGS, PACKINGS, ACCUMULATORS.

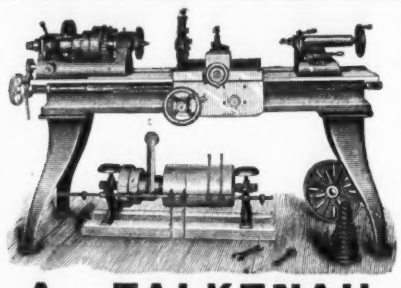
The W. & S. Hydraulic Machinery Works,

WATSON & STILLMAN, Proprietors,

204, 206, 208 & 210 East 43d St., NEW YORK.



Hydraulic U Packings.

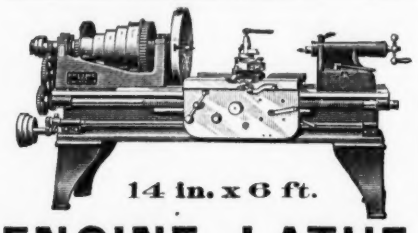


A. FALKENAU,

11th Street & Ridge Ave., Philadelphia, Pa.

MANUFACTURER OF SUPERIOR 14 INCH LATHES, TOOL GRINDING MACHINERY, HYDRAULIC VALVES, ETC.,

Special Machinery designed and constructed.



14 in. x 6 ft.

ENGINE LATHE.

22 in. x 8 ft., 10 ft., 12 ft., 14 ft. x 16 ft.

LATEST IMPROVED

ENGINE LATHES.

Patent Radial Drills a Specialty.

ADDRESS

DIETZ, SCHUMACHER & CO.,

Successors to DIETZ, GANG & CO.,

58 & 60 PENN ST.,

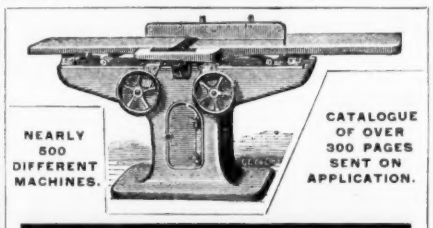
CINCINNATI, O., U. S. A.

ELECTRIC CRANES AND TOOLS.

PAWLING & HARNISCHFEGER,

BUILDERS,

MILWAUKEE, WIS.



NEARLY 500 DIFFERENT MACHINES.

CATALOGUE OF OVER 300 PAGES SENT ON APPLICATION.

THE EGAN CO.,

239 to 259 W. FRONT ST., Cincinnati, Ohio, U. S. A.

Makers of WOOD-WORKING MACHINERY FOR ANY CLASS OF WORK.

WE TOOK THE "GRAND HONORS" at World's Fair.

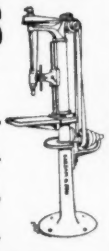
SENSITIVE DRILLS

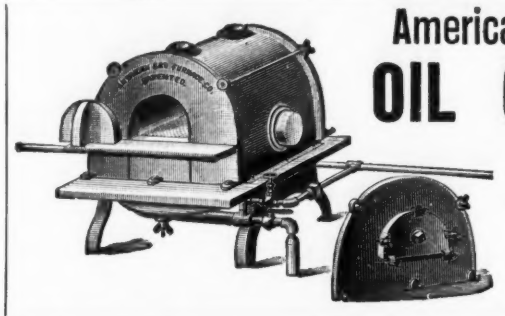
Complete Machines from $16 up.

SEND FOR CIRCULARS.

WM. GARDAM & SON,

98 John St., New York.





American Gas Furnace Co.,

OIL GAS PLANTS

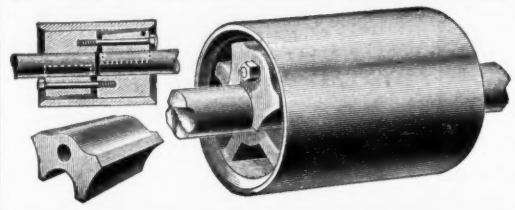
AND

GAS BLAST FURNACES.

Send for Catalogue. Estimates made for any mechanical operation requiring high, even and controllable temperature.

No. 80 NASSAU STREET, NEW YORK.

NO KEYS. NO KEY-SEATING. NO SLIPPING. STUART'S PATENT



Compression Wedge Coupling.

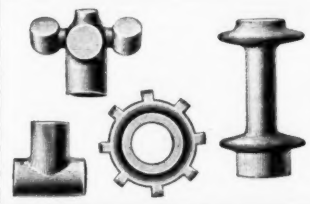
SENT ON TRIAL.

Can be attached or removed in a few seconds without injury to shaft or coupling.

SIMPLEST and BEST in MARKET, Also the Cheapest.

Send for discount and illustrated Price List of 20 sizes.

R. J. STUART'S FOUNDRY AND MACHINE WORKS, NEW HAMBURGH, N. Y.



WYMAN & GORDON

WORCESTER, MASS.

DROP FORGINGS

ELECTRICON.

The Best Anti-Friction Metal in the World.

FOR ALL

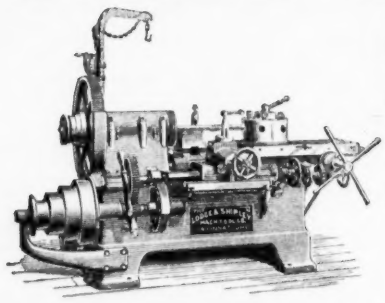
MACHINE, RAILWAY AND MARINE BEARINGS.

HIGH QUALITY. LOW PRICE. SEND FOR SAMPLE.

UNION ELECTRIC COMPANY,

Manufacturers and Sole Agents, 45 BROADWAY, N. Y.

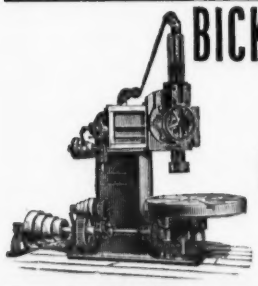
RAPIDITY.



ONE OF OUR MACHINES, using four tools, turns the diameter, squares down both sides and bores twenty blank gears, twenty-three inches in diameter, 4½ in. face, 3⅜ in. bore, per day of ten hours.

SIMPLE TOOLS.
ACCURATE WORK.

The Lodge & Shipley M. T. Co., Cincinnati, O.



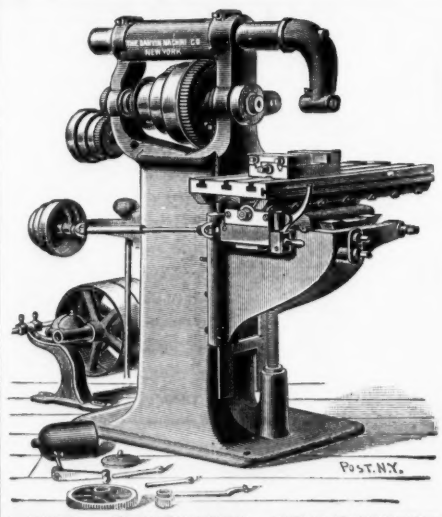
BICKFORD DRILL AND TOOL CO.

3 PIKE STREET, CINCINNATI, OHIO.

BUILDERS OF

UPRIGHT, RADIAL, HALF AND FULL UNIVERSAL RADIAL DRILLS.

BORING AND TURNING MILLS.



OUR NEW No. 3½

MILLING MACHINE

NOW READY FOR

IMMEDIATE DELIVERY.

WRITE FOR

SPECIAL CIRCULAR AND PRICE.

25

OTHER SIZES AND STYLES MADE.

MACHINE TOOLS

OF ALL KINDS IN STOCK.

THE GARVIN MACHINE CO., LAIGHT AND CANAL STS., NEW YORK.

P. BLAISDELL & CO.,

MANUFACTURERS OF

MACHINISTS' TOOLS,

SEND FOR CATALOGUE. WORCESTER, MASS. MENTION THIS PAPER.

A Constant Cutting Speed Machine requires the speed of the main spindle to automatically increase as the tools advance.

Our 2″ machine starts at 48 revs. per min. and increases gradually to 150 revs. per min.

Our 6″ machine starts at 16 revs. per min. and stops at 90 rev. per min.

SEND FOR DESCRIPTIVE CIRCULARS.

HURLBUT-ROGERS MACHINE CO.,

SOUTH SUDBURY, MASS.

THE PERKINS DRAW STROKE TRIMMER,

An Indispensable Tool for all Bench Woodworkers. Latest and Best Design. Infringers Prosecuted. Trial, not orders, solicited.

PERKINS & CO., Grand Rapids, Mich.

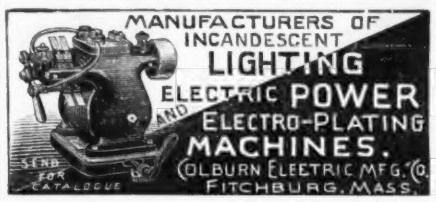
STOCKS, NEAVE & CO., Manchester, England.

J.H.&D. LAKE CO.
MASSILLON O. U.S.A.
MANUFACTURERS OF FRICTION CLUTCH PULLEYS.
PLAIN OR SPLIT IRON CASTINGS, PULLEYS, SHAFTING, HANGERS ETC.
& COUNTER SHAFTS COMPLETE

MORSE TWIST DRILL AND MACHINE COMPANY,

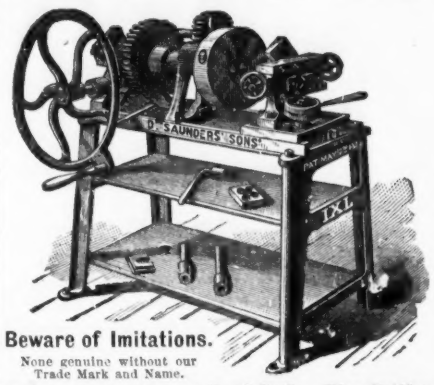
Manufacturers of Morse Patent Straight-Lip Increase Twist Drills. New Bedford, MASS.

Solid and Shell Reamers, Beach's Patent Self-Centering Chuck, Bit Stock Drills.
DRILL GRINDING MACHINES, MILLING CUTTERS AND SPECIAL TOOLS TO ORDER.



D. SAUNDERS' SONS

MANUFACTURERS OF THE ORIGINAL
TRADE I. X. L. MARK.
PIPE CUTTING & THREADING MACHINE



Beware of Imitations.
None genuine without our Trade Mark and Name.

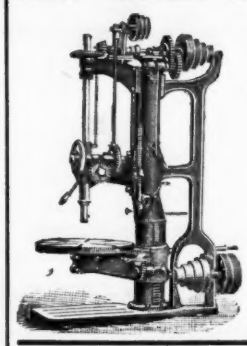
Steam and Gas Fitters' Hand Tools. Pipe Cutting and Threading Machines for Pipe Mill use a specialty.
SEND FOR CIRCULAR.
21 Atherton St., YONKERS, N. Y.

F. E. REED & CO.,

Worcester, Mass.,
MANUFACTURE
ENGINE LATHES
HAND LATHES, FOOT LATHES AND MILLING MACHINES.
Manning, Maxwell & Moore,
Selling Agents, 111 Liberty St., New York.
515 Phenix Building, Chicago.

NEW HAVEN MANUF'G CO.,

New Haven, Conn.



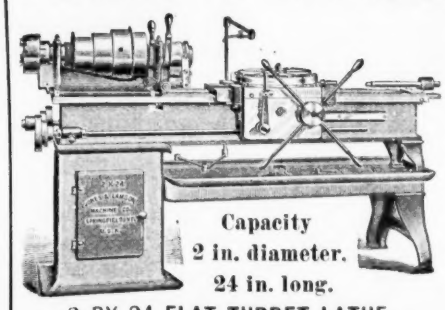
Lathes, Planers, Shapers, Slotters, Etc.

Back Volumes of the AMERICAN MACHINIST for 1880, '82, '83, 84, '85, '87, '88, '89, '90, '91 and '92.
A FEW MAY STILL BE HAD.
Address AMERICAN MACHINIST, 203 Broadway, N. Y

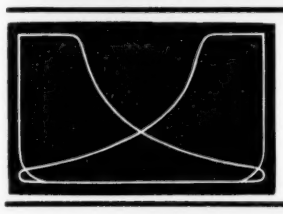
THE BEST WORKMEN ARE USING
GROBET SWISS FILES.
MONTGOMERY & CO.,
105 FULTON STREET, NEW YORK CITY.

JONES & LAMSON MACHINE CO.,

SPRINGFIELD, VERMONT.
SOLE BUILDERS OF THE
FLAT TURRET LATHE.
ALSO BUILDERS OF OTHER
TURRET MACHINERY.
PUBLISHERS OF
"RAPID LATHE WORK,"
BY NEW METHOD.
(Hartness System.)
SEND FOR CATALOG.



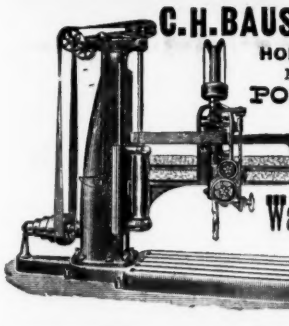
Capacity
2 in. diameter.
24 in. long.
2 BY 24 FLAT TURRET LATHE.



MAKE YOURSELF A MECHANICAL ENGINEER OR DRAUGHTSMAN; or qualify to take charge of, or to superintend the manufacture of Machinery, by devoting your idle hours to **Home Study**, by the method of

THE CORRESPONDENCE SCHOOL OF MECHANICS, SCRANTON, PA.

The course embraces instruction in Arithmetic, Algebra, Geometry, Trigonometry, Elementary Mechanics, Hydromechanics, Pneumatics, Heat, Mechanical Drawing, Steam and Steam Engines, Strength of Materials, Applied Mechanics, Boilers, Machine Design, Electricity, Etc. To begin, Students need only know how to read and write. **Moderate Charges. Diplomas Awarded. Send for Free Circular Giving full Particulars.**



C. H. BAUSH & SONS,

HOLYOKE, MASS.
Manufacturers of
POST, SUSPENDED AND Wall Radial Drills
From the smallest to the largest.

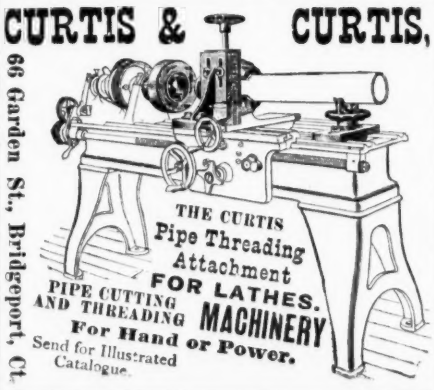
BARKER'S IMPROVED CENTER GRINDING MACHINE.

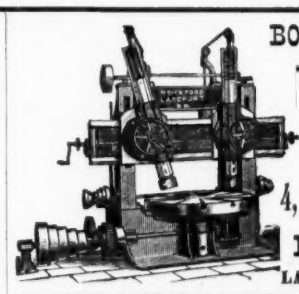
NO GAUGES. NO BELT.
Every Machine Guaranteed.
MANUFACTURED BY
WM. BARKER & CO., Cincinnati, Ohio.
SEND FOR CIRCULAR

IF YOU HAVE ANY SMALL ARTICLES in Brass or Iron that you want manufactured in quantities, write to THE JONES BROS. ELECTRIC Co., 28-30-32 West Court St., Cincinnati, O.

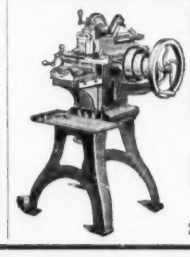
CURTIS & CURTIS,

66 Garden St., Bridgeport, Ct.



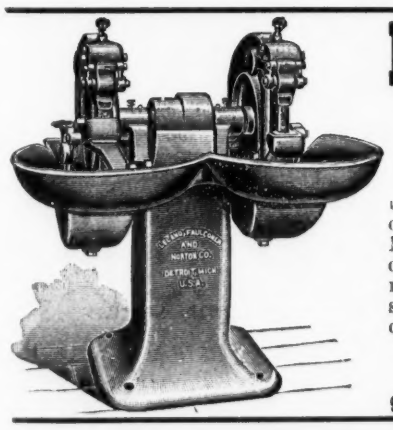


BORING AND TURNING MILLS,
4, 5, & 6 ft. Swing
H. Bickford,
LAKEPORT, N. H.



BOYNTON & PLUMMER,

WORCESTER, MASS.
Manufacturers of
Shaping Machines, Drilling Machines, Bolt Cutting Machines.
CHAS. CHURCHILL & CO., Lt'd,
21 Cross St., Finsbury, London.



LELAND, FAULCONER & NORTON CO.

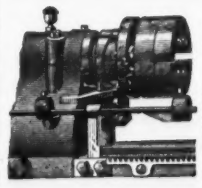
WET EMERY GRINDER.

Any amount of water easily applied without the use of Pump, Hose, Treadles, Cocks, or any of the objectionable features common in this class of Machine. Truing Device, which is inexpensive, does the work perfectly and quickly. The whole rig practically as simple as the old-fashioned grind stone trough and much more effective. Send for circular.

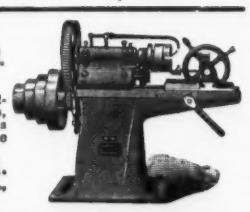
LELAND, FAULCONER & NORTON CO.,
96 TO 106 BATES STREET, DETROIT, MICH.

Pat. KEY-SEAT SETTING GAUGE
PATENT UNIVERSAL SCREW-CUTTING CENTER
DEPTH ANGLE AND TWIST DRILL GAUGE
J. WYKE & CO
Fine Machinists Tools. E. BOSTON, MASS. Send for LISTS

ADAMS
Automatic Bolt-Threading & Nut Tapping Machine.
Made in all Sizes to Cut from 1-4" to 6".



The simplest and most durable machine in existence. The threading head is made entirely of steel. No links, levers, springs, caps, cases, blocks or die rings in or about the head. Separate Heads and Dies Furnished. Write for descriptive circular and price list to
Capitol Mfg. Co., 125 to 137 Rees St., Chicago, Ill., U. S. A.
Agents for Great Britain, CHARLES CHURCHILL & CO., Ltd., 21 Cross Street, Finsbury, London, E. C., England.



SMALL CRANKS AND ENGINE PARTS MADE.

W. D. FORBES & CO., HOBOKEN, N. J. 1300 HUDSON STREET.

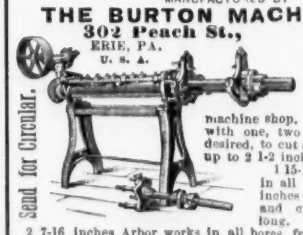
MILLING CUTTERS, FINE TOOLS, SPECIAL MACHINES, HARDENED ARBORS.

HAMILTON MACHINE TOOL CO.,

N. E. Cor. Water & Market Sts.,
Hamilton, Ohio, U. S. A.
MODERN
16", 22", 26", 32" and 36"
Back Geared and Power Feed
DRILL PRESSES
A SPECIALTY.
CORRESPONDENCE SOLICITED.

THE ERIE KEY-SEATING MACHINE.

MANUFACTURED BY
THE BURTON MACHINE CO.,
302 Peach St.,
ERIE, PA. U. S. A.



Send for Circular.

The cut represents our Stationary and Portable Key-Seating Machine which fully meets all the requirements of a machine shop. They are furnished with one, two or three Arbors as desired, to cut any width of key-seat up to 2 1-2 inches wide.

1 15-16 inches Arbor works in all bores from 1 15-16 inches to 3 inches diameter, and cuts seats 12 inches long.

2 7-16 inches Arbor works in all bores from 2 7-16 inches to 6 inches diameter, and cuts seats 16 inches long.

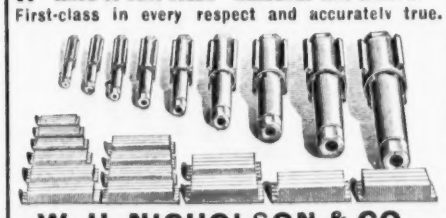
4 7-16 inches Arbor works in all bores from 4 7-16 inches to 14 inches diameter, and cuts seats 26 inches long.

With an attachment for the purpose seats can be cut in holes as small as 1 inch diameter, by one passage of the cutter.

If the work is heavy and too large to be placed on machine it can be detached from stand and used as portable machine.

NICHOLSON'S EXPANDING MANDRELS,

MADE OF BEST STEEL—HARDENED AND GROUND.
First-class in every respect and accurately true.

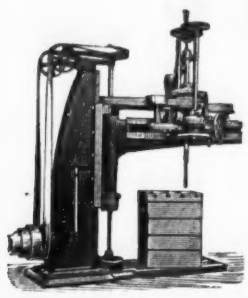


W. H. NICHOLSON & CO.,
MANUFACTURERS OF
MECHANICAL SPECIALTIES,
WILKES BARRE, PA.

BARNES' WATER EMERY TOOL GRINDER

Has no pumps, no valves. No piping required to supply it with water. Always ready for use. Simplest in construction, most efficient in operation. Send for Catalogue and Prices.

W. F. & John Barnes Co.
1995 RUBY ST.,
ROCKFORD, ILL.
ENGLISH AGENTS,
CHAS. CHURCHILL & CO., LTD.
21 CROSS ST., FINSBURY. LONDON, E. C., ENG.



WM. SELLERS & CO., Incorporated.

PHILADELPHIA, PA.

MANUFACTURERS OF

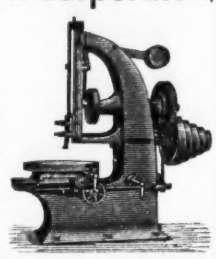
MACHINE TOOLS,

TRAVELING CRANES AND SWING CRANES,

Operated by Electricity, Shafts or Independent Engines.

Turn Tables, Testing Machines, Shafting, Pulleys, Hangers, Couplings, Etc.

INJECTORS FOR ALL CLASSES OF BOILERS.

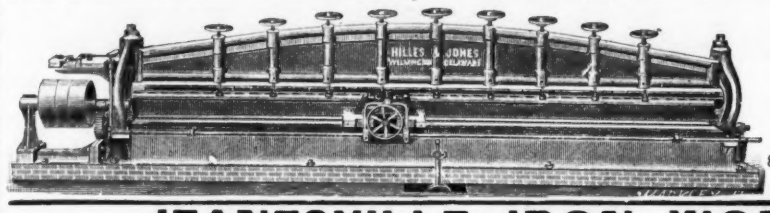


THE HILLES & JONES CO., WILMINGTON, DEL.

MANUFACTURERS OF

MACHINE TOOLS,

For Boiler Makers, Bridge Builders, Ship Builders, Railroad Shops, Locomotive and Car Builders, etc.

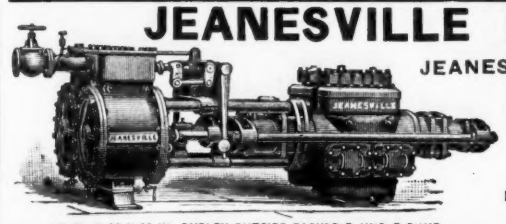


Improved Boiler Plate Planer.

Eight Sizes.

8'x20' length of cut.

JEANESVILLE IRON WORKS,



24 IN. X 10 X 12 IN. DUPLEX OUTSIDE PACKED PLUNGER PUMP.

JEANESVILLE, LUZERNE CO., PA.,

BUILDERS OF

SPECIAL PUMPS OF ALL KINDS.

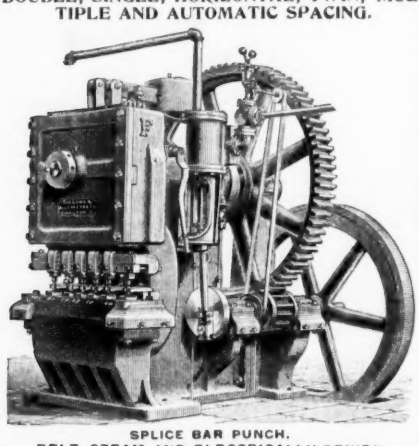
DUPLEX OR SINGLE, SIMPLE OR COMPOUND.

MINE PUMPS, SINKING PUMPS, PRESSURE PUMPS, VACUUM PUMPS, ARTESIAN WELL PUMPS, POWER PUMPS, ETC., ETC.

The LONG & ALLSTATTER CO.

HAMILTON, OHIO.

DOUBLE, SINGLE, HORIZONTAL, TWIN, MULTIPLE AND AUTOMATIC SPACING.



SPLICE BAR PUNCH.

BELT, STEAM AND ELECTRICALLY DRIVEN

POWER PUNCHES AND SHEARS.

THE MERRELL MFG. CO.

Cor. Curtis and Charles St.,

TOLEDO, OHIO,

Manufacture The Best and Most Complete Line of Hand And Power

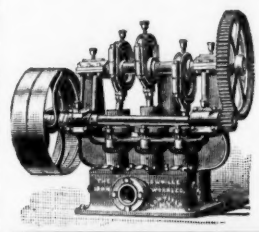
PIPE THREADING MACHINERY IN USE.

Send for Catalogue.

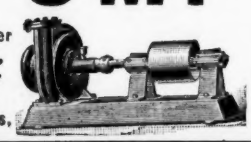
LOWVILLE IRON WORKS CO., LOWVILLE, N. Y.

MANUFACTURERS OF

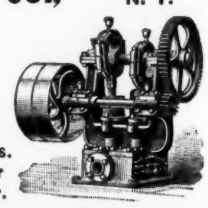
PUMPS



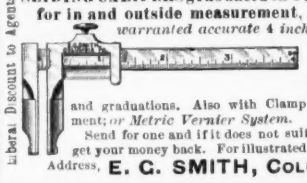
For Boiler Feeding, Elevator Work, Pulp Mills,



and other purposes. Send for Circular.



Liberal Discount to Agents.



SLIDING CALIPERS graduated in 64ths and 100ths for in and outside measurement, hardened jaws

warranted accurate 4 inch with 1¼ jaws by mail $2.50

6 inch with 1¾ jaws by mail $3 00

Made in all sizes and graduations. Also with Clamp and screw adjustment; *or Metric Vernier System.*

Send for one and if it does not suit you return it and get your money back. For illustrated circular and prices, Address, E. C. SMITH, COLUMBIA, PA.

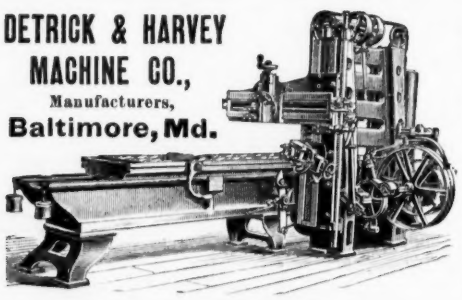
AUTO MATIC PENBERTHY INJECTOR

PENBERTHY INJECTOR CO. MFRS, DETROIT, MICH.

DETRICK & HARVEY MACHINE CO.,

Manufacturers,

Baltimore, Md.



OPEN SIDE PLANERS.

Ready for Immediate and Prompt Delivery.

Size C (30″ x 30″) to plane 6 feet long.
Size C (30″ x 30″) to plane 8 feet long with extra side head.
Size C (30″ x 30″) to plane 12 feet long with extra side head.
Size D (36″ x 36″) to plane 10 feet long with extra side head.
Size D (36″ x 36″) to plane 12 feet long with extra side head
Size F (48″ x 48″) to plane 14 feet long with extra side head.
Size F (48″ x 48″) to plane 16 feet long with extra side head.

THE VERNON COUNTING REGISTER.

Positive Motion, Steel Gearing, Brass Wheels.

Absolutely Accurate at High Speed.

For Counting Strokes of Engines, Pumps, Speed of Shafting and Automatic Machines, Registering Fares in Turnstiles, etc., etc.

THE DAVIDS MACHINE WORKS,

MANUFACTURERS AND SOLE AGENTS.

OFFICES: 129 WORTH ST., NEW YORK.

ENGINE CASTINGS

⅛ to 2 H.P. Upright, Horizontal and Marine. Illustrated Booklet free on receipt of stamp. Gas Engine and Dynamo Castings. Small Boilers. Experimental work for inventors.

A. L. WEED & CO.,

106 LIBERTY STREET, NEW YORK.

STEEL CASTINGS

FROM 1 TO 40,000 POUNDS WEIGHT.

Of Open Hearth, Chester or Bessemer Steel.

True to Pattern. Sound. Solid.

GEARING OF ALL KINDS, CRANK SHAFTS, KNUCKLES FOR CAR COUPLERS.

Cross Heads, Rockers, Piston-Heads, etc., for Locomotives. Steel Castings of Every Description.

CHESTER STEEL CASTINGS CO.,

Works, Chester, Pa. Office, 407 Library St., Philadelphia, Pa.

ROBERT POOLE & SON CO.

ENGINEERS & MACHINISTS.

TRANSMISSION MACHINERY

MACHINE MOULDED GEARING

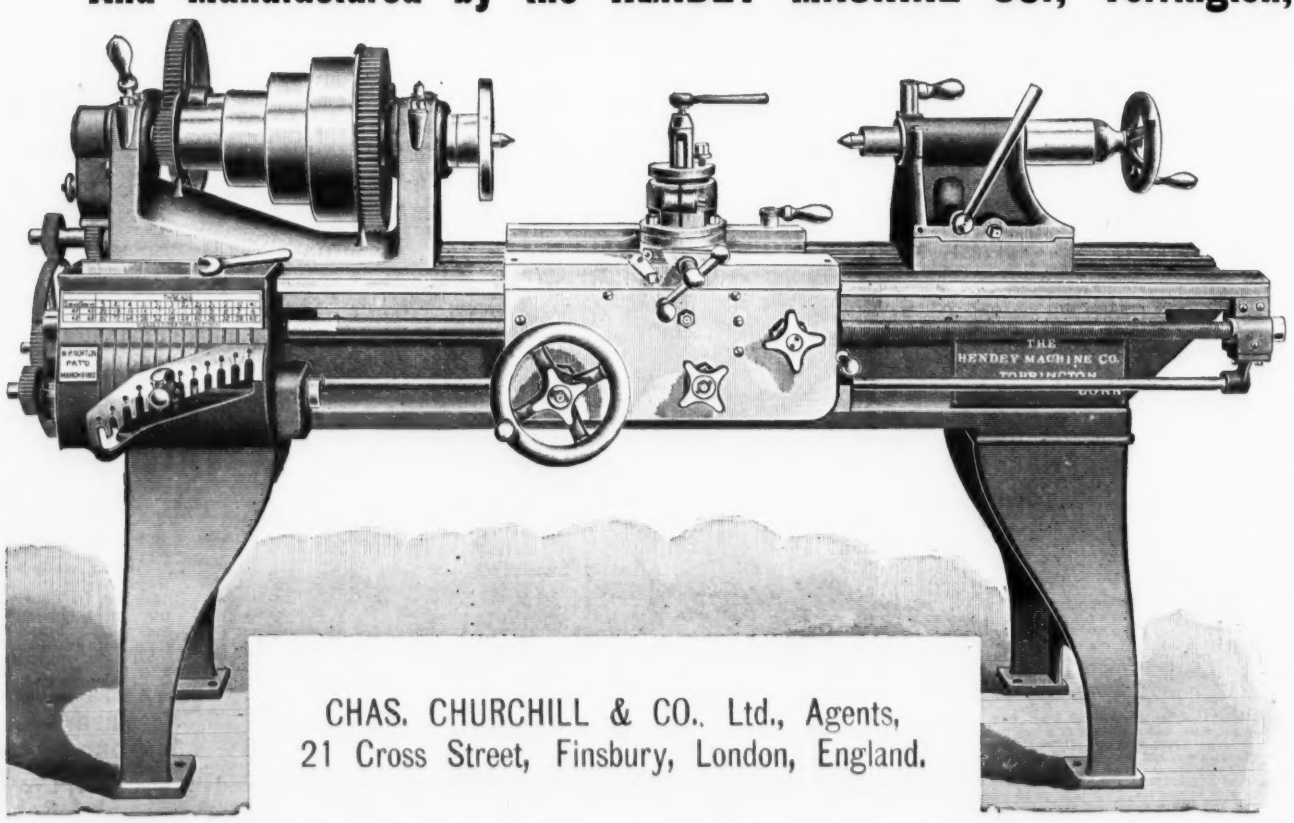
SPECIAL FACILITIES FOR THE HEAVIEST CLASS OF WORK

BALTIMORE, MD.

THE NORTON IMPROVED SCREW-CUTTING ENGINE LATHE,

PATENTED MARCH 8TH, 1892,

And Manufactured by the HENDEY MACHINE CO., Torrington, Conn., U. S. A.



CHAS. CHURCHILL & CO., Ltd., Agents,
21 Cross Street, Finsbury, London, England.

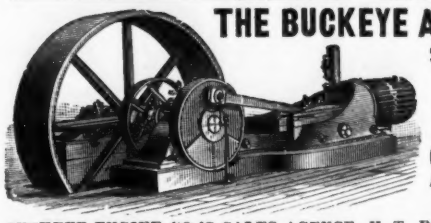
THIS LATHE

Cuts 12 different screws, 6 to 20 without changing the gears, and feed changes from 30 to 100 cuts per inch without change.

Has Hollow Spindle or not as preferred, Compound or Elevating Tool Rest, Power Cross Feed, Taper Attachment. Carriage reverses for screw cutting without the use of the counter shaft, from the lever at end of carriage, allowing the spindle to run in one continuous direction.

Lathe furnished to responsible parties on 30 days' trial.

Send for Descriptive Circular.



THE BUCKEYE AUTOMATIC CUT-OFF ENGINES.

SLOW SPEED, MEDIUM SPEED AND HIGH SPEED ENGINES,

Simple, Compound and Triple-Expansion Engines

HIGH-PRESSURE BOILERS.

Complete Steam Power Plants of Highest Attainable Efficiency.

Address BUCKEYE ENGINE CO., Salem, O.

OR SALES AGENTS:

BUCKEYE ENGINE CO.'S SALES AGENCY, H. T. PORTER, No. 10 Telephone Building, New York City.
A. A. HUNTING, John Hancock Bld'g, Boston, Mass. N. W. ROBINSON, 97 Washington St., Chicago, Ill.
ROBINSON & CARY COMPANY, St. Paul, Minn. A. L. FISH, No. 61 First St., San Francisco, Cal.
A. M. MORSE, 511 Commercial Building, St. Louis, Mo. J. M. ARTHUR & CO., Portland, Oregon.

ALBANY STEAM TRAP CO., ALBANY, N. Y.

RETURN STEAM TRAPS, SPECIAL

BOILER FEED PUMPS

AND

PUMP GOVERNORS.

AUTOMATIC

STEAM PUMPS

AND GOVERNOR COMBINED

FOR PUMPING

HOT CONDENSED WATER.

Renewable Seat and Disc

VALVES.

"OTTO" GAS ENGINE WORKS.

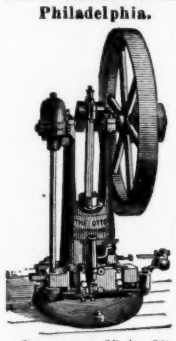
SCHLEICHER, SCHUMM & CO.,

33d & Walnut Streets, Philadelphia.

245 Lake Street, Chicago.

New York Agency, 18 Vesey St.

35,000 SOLD.



MANY NEW IMPROVEMENTS

FOR USE WITH

COAL GAS, NATURAL GAS, PRODUCER GAS, OR GASOLINE.

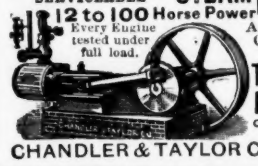
COMBINED

"OTTO" GAS ENGINES AND PUMPS.

Consume 25 to 75 Per Cent. Less Gas than ANY other Gas Engine doing the same work.

STRONG, WELL BUILT SERVICEABLE **STEAM ENGINES**

12 to 100 Horse Power



Every Engine tested under full load.

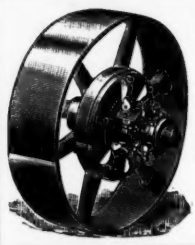
Adapted to Heavy, Continuous Work.

SUITABLE

Tubular & Firebox **BOILERS**

on hand for immediate delivery.

CHANDLER & TAYLOR CO. INDIANAPOLIS, IND.



The Moore & White Co.,

15th St. & Lehigh Ave., PHILADELPHIA, PA.

MFRS. OF

The "Moore & White"

Friction Clutches

AND

Cut-off Couplings.

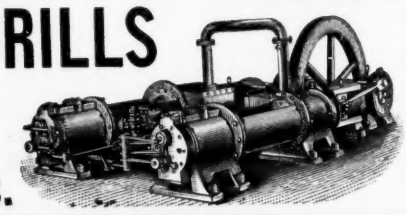
Send for Circulars.

ROCK DRILLS

AND

AIR

COMPRESSORS.



AIR COMPRESSORS WITH COMPOUND AIR CYLINDERS, AND COMPOUND STEAM CYLINDERS WITH MEYER OR CORLISS VALVES.

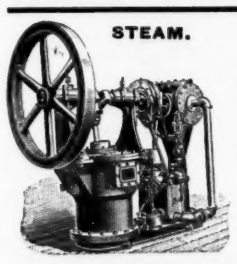
RAND DRILL CO.,

23 Park Place,

NEW YORK, U. S. A.

BRANCH OFFICES: Monadnock Building, Chicago; Ishpeming, Mich.; 1316 18th St., Denver; Sherbrooke, P. Q., Canada; Apartado 830, Mexico City.

STEAM.



CONOVER CONDENSERS.

BELT AND STEAM DRIVEN.

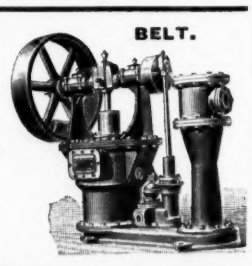
Compound Condensing Corliss Engine on Independent Condenser.

HANDSOME CATALOGUE FREE.

THE CONOVER MFG. CO.,

39 & 41 CORTLANDT STREET, N. Y.

BELT.



LINK-BELT

ENGINEERING CO.

NICETOWN.

PHILA.

49 DEY ST.

NEW YORK.

Elevators, Conveyors, Manilla Rope Power Transmission Machinery, Ewart Detachable Link Belting Dodge Chain, Howe Chain, etc. (Chicago-Link-Belt Machinery Co.)

CHAS. A. STRELINGER & CO.,

Tools, Supplies and Machinery,

DETROIT, MICH.

A MARVEL OF POWER SIMPLICITY & LOW COST

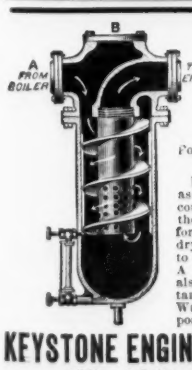
ALWAYS READY, NO BOILER, NO FIRE, NO ENGINEER, NO LICENSE, NO DANGER. STATIONARY, MARINE AND PORTABLE ENGINES FOR BOATS, PUMPS, FACTORIES ETC.

SMALL SIZES A SPECIALTY.

SAFETY VAPOR ENGINE CO., 16 MURRAY ST. NEW YORK.

SEND FOR CATALOGUE

DRY STEAM.



Simpson's Centrifugal Steam Separator.

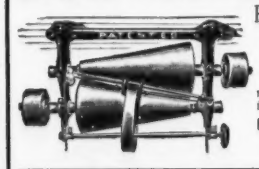
For Supplying Clean and Dry Steam to Engines, Dry Houses, etc.

Place Separator as close to engine as possible, the steam taking a spiral course between the threads causes the water to be thrown by centrifugal force against the outer walls, while the dry steam goes through the small holes to center of pipe. Steam can enter at A or B, as convenience may require; also used in conveying steam long distances, for Steam Hammers, Dry Houses, Water Gas Generators, and for all purposes where Dry Steam is necessary.

KEYSTONE ENGINE & MACHINE WORKS.

Fifth and Buttonwood Streets, Philadelphia.

EVANS FRICTION CONE CO.



HANGING AND STANDING

CONES,

MADE IN ALL SIZES.

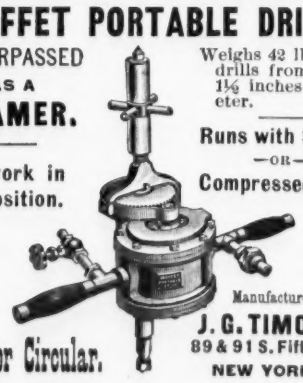
Thousands in use transmitting from 1 to 50 H. P. For information address,

No. 85 WATER STREET, BOSTON, MASS.

MOFFET PORTABLE DRILL.

UNSURPASSED AS A **REAMER.**

Will work in any position.



Weighs 42 lbs. and drills from ¾ to 1¼ inches diameter.

Runs with Steam —OR— Compressed Air.

Manufactured by

J. G. TIMOLAT,

89 & 91 S. Fifth Ave., NEW YORK.

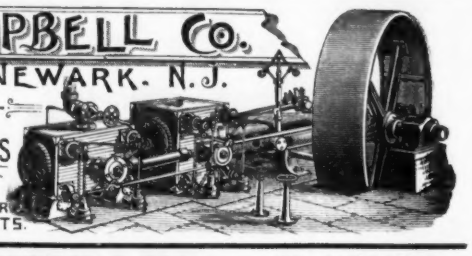
Send for Circular.

THE WATTS, CAMPBELL CO.

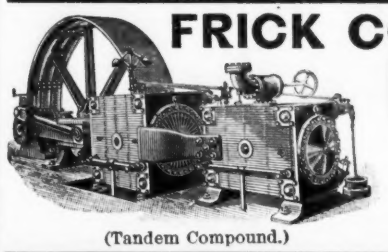
MANUFACTURERS OF IMPROVED CORLISS STEAM ENGINES IN FULL VARIETY.

NEWARK, N. J.

CONTRACTS TAKEN FOR COMPLETE POWER PLANTS.



FRICK COMPANY, WAYNESBORO, PA.



(Tandem Compound.)

ECLIPSE CORLISS ENGINES,

40 TO 2,000 H. P., ALL STYLES.

Send for Illustrated Catalogue.

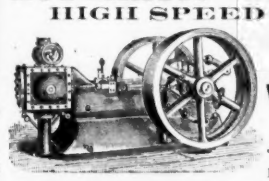
ALSO BUILDERS OF

Electric High Speed Engines and Ice-Making and Refrigerating Machinery.

WESTON

HIGH PRESSURE BOILERS AND COMPLETE POWER PLANTS

AUTOMATIC HIGH SPEED



ENGINES

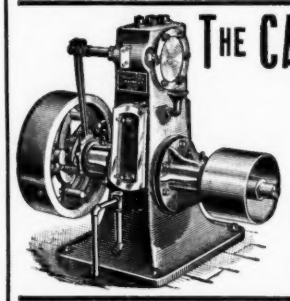
WESTON ENGINE CO.,

PAINTED POST, N. Y.

REPRESENTATIVES

JULIAN SCHOLL & CO., 126 Liberty St., N. Y.
GEO. D. HOFFMAN, 82 Lake St., Chicago.
H. M. SCIPLE & CO., 34 & Arch Sts., Phila, Pa.

THE CASE AUTOMATIC HIGH SPEED ENGINE



SIMPLICITY, COMPACTNESS.

Automatic Lubrication, Perfect Regulation,

The Latest Development in High Speed Engine Building.

BUILT IN SIZES FROM 2½ to 25 H. P.

Manufactured by THE J. T. CASE ENGINE CO.,

New Britain, Conn., WM. S. HINE, Gen'l Sales Mgr.

PIERCE & MILLER ENGINEERING CO., Selling Agents for New York and Export, 42 Cortlandt Street, N. Y.

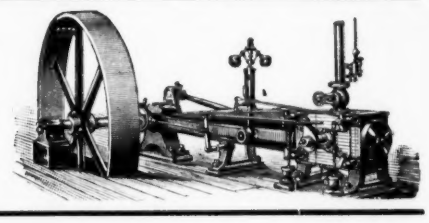
PHILADELPHIA CORLISS ENGINES,

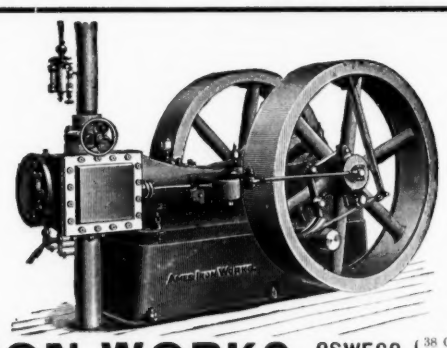
Simple, Compound and Triple-Expansion,

ALL SIZES.

Philadelphia Engineering Works, Ltd.

Mifflin St., East of Front, PHILADELPHIA, PA.



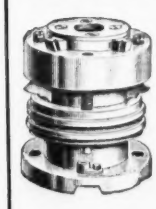


AMES IRON WORKS, OSWEGO, N. Y.

38 Cortlandt Street, New York City.
18 South Canal Street, Chicago, Ill.
50 Oliver Street, Boston, Mass.
518 Arch Street, Philadelphia, Pa.

Bolt and Nut Machinery.

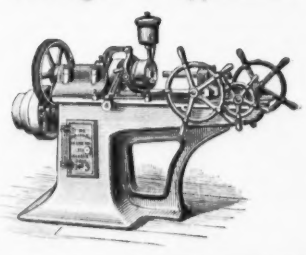
Catalogue on Application.



Complete Outfits for Bolt and Car Shops.

Bolt Cutters, Bolt Pointers, Upsetters and Benders, Bolt Headers, Nut Tappers, Nut Machines, Washer Machines, Car Link and Pin Machinery.

The National Machinery Co., Tiffin, O.



THE MACHINERY I make is the very kind YOU want. Every machine bears the imprint of my brain, as well as my name. Of the best workmanship and the finest material, it does the best work, saves the most time and makes you the most money.

Send for a catalogue.

P. PRYIBIL, 498 to 510 West 41st Street, New York.

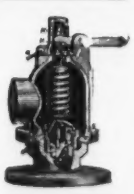
Machinery Catalogues. { A. WOODWORKING MACHINERY. B. MACH'Y FOR BRASS, IVORY, HORN, ETC. C. SHAFTING, PULLEYS, HANGERS, ETC.

LONERGAN'S SPECIALTIES

Oil Cups for all Purposes. Sight Feed Lubricators. Pop Safety Valves, Check Valves, Water Relief Valves, etc. "Clipper" Injectors, and other Steam Appliances.

J. E. LONERGAN & CO., 211 Race St., Phila., Pa.

CATALOGUE FREE ON APPLICATION.



BROWN & SHARPE MFG. CO.,

PROVIDENCE, R. I.

DISCOUNTS.

On all Lists of Cutters on pages 134, 135, 136, 137, 138, 139, 140, 141, 142, 143, 144, 145, 146, 147, 148, 151, 152, 153, 155 and 156 of 1893 catalogue, we **discount 15%.**

If 100 or more Screw Slotting Cutters of any one size are ordered at one time, we make an extra **discount of 25%.**

On the price-lists of Gears we **discount 40%**, and we make special price for a large number of Gears of any one size.

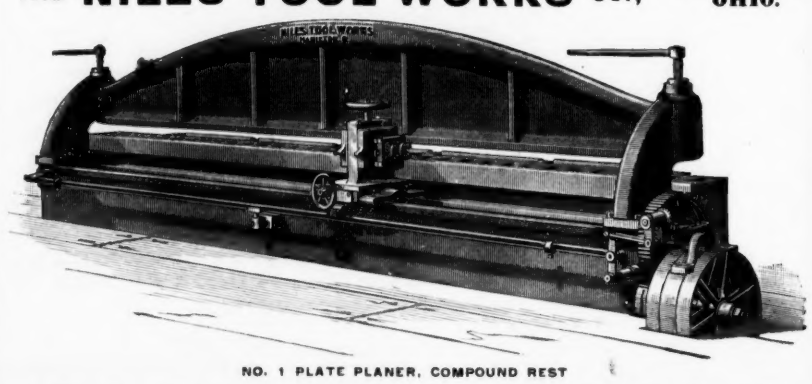
These discounts are subject to change without notice.

Special prices will be made on Standard Internal and External Cylindrical Gauges and Standard Caliper Gauges when ordered in large quantities.

The other articles, illustrated in catalogue, are not subject to discount.

ENGLAND—BUCK & HICKMAN, 280 Whitechapel Road. London, E.
GERMANY G. DIECHMANN, Ansbacherstr, 5 Berlin W. 62.
FRANCE—FENWICK FRERES & CO., 21 Rue Martel. Paris.
FRANCE—F. G. KREUTZBERGER, 140 Rue de Neuilly Puteaux (Seine).
CHICAGO, ILL.—FRED. A. RICH, 23 South Canal St.

THE **NILES TOOL WORKS** CO., HAMILTON, OHIO.



NO. 1 PLATE PLANER, COMPOUND REST

MACHINE TOOLS.

NEW YORK, BOSTON, CHICAGO, PHILADELPHIA, PITTSBURGH.

JENKINS STANDARD PACKING

for Steam or Joint Packing, has no superior. It is manufactured in all thicknesses. It is **not loaded** to increase weight. Does **not rot or burn out.** Every sheet is stamped with Trade Mark, like cut.

JENKINS BROS.,
NEW YORK, PHILADELPHIA, BOSTON and CHICAGO.

BEMENT, MILES & CO.,

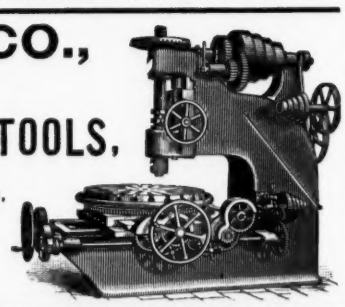
PHILADELPHIA, PA.

BUILDERS OF

METAL-WORKING MACHINE TOOLS,

FOR

RAILROAD SHOPS, LOCOMOTIVE AND CAR BUILDERS, MACHINE SHOPS, ROLLING MILLS, STEAM FORGES, SHIP-YARDS, BOILER SHOPS, BRIDGE WORKS, ETC., ETC.



NEW YORK OFFICE, EQUITABLE BUILDING.
GEORGE PLACE, Agent.

SPUR- AND SPIRAL-GEARED

PLANERS

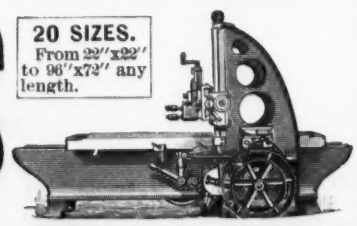
("SELLERS' MOTION")

MADE BY

The G. A. GRAY CO.,

477-483 SYCAMORE ST., CINCINNATI, O.

20 SIZES.
From 22"x22" to 96"x72" any length.



WRITE FOR PRICES AND PHOTOS

GOULD & EBERHARDT,

N. J. R. R. Ave., Green & Bruen Sts., NEWARK, N. J.

SHAPER

Gives 50 to 100 per cent. MORE strokes per minute THAN ANY OTHER MAKE OF SHAPER NOW BUILT.

9 to 15 RICHARDS ST.,
BROOKLYN, N. Y., March 17, 1892.

GOULD & EBERHARDT, Newark, N. J.

Gentlemen:—We are obliged for your order, No. 5130, which is forwarded to-day as per bill herein.

We always thought that the three Shapers we have of your former style were good machines, but are glad to say that the two recently purchased of the newer pattern are much superior to them. We like them better, for our work, than any other similar tool of which we know.

Yours truly, J. H. WILLIAMS & CO.

Cut represents 16 in., 20 in., 24 in. stroke.

"DOUBLE TRIPLE QUICK" STROKE.

(TRADE MARK.)

Tools can be seen in operation in Manning, Maxwell & Moore's Machine shop, Annex Machinery Hall, World's Columbian Exposition, Chicago, Ill.

THE PRATT & WHITNEY CO.

HARTFORD, CONN., U. S. A.,

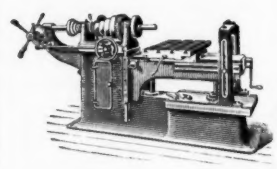
Invite correspondence from all who have use for Forging and Finishing Machinery, with Dies, Fixtures, Milling Cutters and Gauges, for the manufacture, on the American System of Interchangeability of Parts, of Fire Arms, Sewing Machines, Bicycles, Typewriters, Electrical Apparatus, etc., or for Machines and small tools for finishing brass in the forms of Gas fixture Joints and Keys, Locomotive Fittings and Plumbers' Goods.

THE BILLINGS & SPENCER COMPANY
HARTFORD, CONN.

MANUFACTURERS OF

Machinists' Tools — *Pliers*
Hammers — *Wrenches*
Ratchet Drills — *Taps*
Eye Bolts — *Carbon Tongs*
Gauges — *Hand Vises*

QUALITY THE BEST
DROP FORGINGS OF ALL DESCRIPTIONS



WARNER & SWASEY,

CLEVELAND, OHIO.

MANUFACTURERS OF

HORIZONTAL

BORING MILLS.

IRON AND BRASS WORKING MACHINE TOOLS.
SEND FOR ILLUSTRATED CATALOGUE.

GEO. W. FIFIELD,

MANUFACTURER OF

ENGINE LATHES

FROM 17 TO 50 IN. SWING.

Cuts, Photographs and Prices furnished on application.

Lowell, Mass., U. S. A.

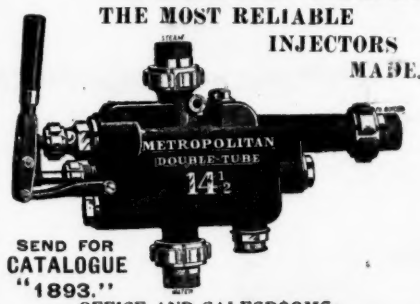
THE HAYDEN & DERBY MFG. CO.,

SOLE MANUFACTURERS

METROPOLITAN INJECTORS,

AUTOMATIC and DOUBLE-TUBE.

THE MOST RELIABLE INJECTORS MADE.



SEND FOR CATALOGUE "1893."

OFFICE AND SALESROOMS:
No. 111 & 113 LIBERTY ST., NEW YORK.

PRICES REDUCED

ON

20 in. W. & L. DRILLS.

LARGE STOCK,
QUICK DELIVERY.

Write for Catalogue and Prices.

W. P. DAVIS,
Rochester, N. Y.

WYMAN & GORDON
WORCESTER, MASS.
DROP FORGINGS
— WOOD WORKERS' VISES —

HARTFORD STEAM BOILER INSPECTION AND INSURANCE CO.

J. M. ALLEN, PRESIDENT.
WM. B. FRANKLIN, VICE-PRESIDENT.
F. B. ALLEN, SECOND VICE-PRESIDENT
J. B. PIERCE, SECRETARY & TREASURER.

THE ACME MACHINERY CO.

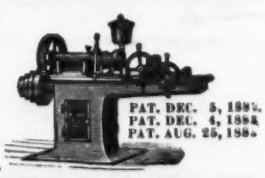
CLEVELAND, OHIO.

Manufacturers of

ACME BOLT & RIVET HEADERS,

Acme Single & Double Automatic BOLT CUTTERS.
Cutting from 1-8 in. to 6 in. diameter.
Also SEPARATE HEADS and DIES.

FIRST PREMIUM CINCINNATI CENTENNIAL.



FOR SALE CHEAP.

We intend to take out several of our old style lathes from 14" to 18" swing, 6 to 10 ft. beds to be replaced by

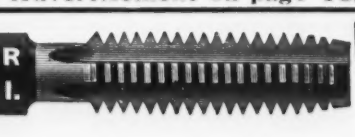
IMPROVED HENDEY-NORTON LATHES

and offer them at moderate prices. They are in first-class condition, some having been used less than a year.

THE HENDEY MACHINE CO., TORRINGTON, CONN.

See our Advertisement on page 18.

J.M.CARPENTER
PAWTUCKET.R.I.



Manufacturer —of— TAPS & DIES